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ROENTGENOLOGICAL AND EXPERIMENTAL STUDIES ON THE PATHOGENESIS OF THE DYSCHONDROPLASIA

(Ollier's Disease) [1, 2]

by

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(Tabulæ VIII—XII)

(The experiments on animals have been made at the Laboratory of Animal Physiology of the Royal College of Agriculture in Copenhagen. Chief: Professor H. Møllgaard.)

On the 15th of January 1922 a girl of 15 years, whose anamnesis is briefly reported here, was admitted to our private clinic.

The patient comes from a healthy family, among whose members no congenital deformities are to be found. She has never showed any symptoms of rachitis, and her general health has always been good, except for some rather mild, periodical dyspeptic troubles.

When she was five years old, her parents noticed for the first time that her right leg was a little shorter than the left one. During her growth this shortness has become ever more pronounced. It ought to be mentioned that the patient has three times contracted fractures. Nine years old, she fractured the internal epicondyle of the left humerus, 11 years old she fractured the lower portion of the femur of her right (short) leg, and 14 years old she fractured the internal condyle of the humerus of the other side, the right. The two fractures of the elbow were both of them due to considerable traumata (falls from great heights), and were both of them typical separations of the epiphysis; as to them, there is no reason to suspect any predisposing fragility of the bone. But it is quite different with regard

[1] The author has read papers on this subject at the meetings of the Northern Orthopedic Association, in Christiania 1922, in Stockholm 1923, and in »Biologisk Selskab» in Copenhagen May 1923.

[2] The *Rask-Ørsted Foundation* has kindly payed the author's expenses in publishing this paper.

to the fracture of the femur; it was caused by a simple spill with a bicycle, and it occurred in a place where the changes in the structure of the bone, which will be mentioned below, were rather extensive.

Except for the fractures, the upper extremities have never shown anything abnormal.

There has never been any pains in the short leg, never paresis; she has been able to walk quite well and for long distances, without any limp worth mentioning, although the shortening has gradually reached 8 cm., and the heel of her boot on this side is only $2^1/_2$ cm, higher than that on the other side.

Fig. 1.

As will be seen in fig. 1, the patient is of a normal and harmonic build, but for the very considerable shortness of her right leg, which causes a tendency to keep the spinal column in a position of a long dextro-convex scoliosis. The joints of the hip and the knee have a normal mobility; the dorsal flexion of the ankle-joint is somewhat restricted on account of a slight contraction of the musculus triceps suræ, which may be due to the patient's habit of walking on her toes. The muscles are well developed. The circumference of the thighs, measured 16 cm. above the patella, and that of the thickest part of the calves, are alike on either side.

The patient has brought a good many roentgenograms taken from time to time by Dr. Klubien, Helsingör, to whom I owe my best thanks for his permission to publish them. Fig. 2, plate VIII shows a roentgenogram of the crura, when the patient was 7 years old. It will be seen that the right crus was even then considerably shorter than the left one. Moreover, some very remarkable structural changes are seen in both metaphyses of the tibia. In the upper part are found some mainly longitudinal, stripe-shaped, sharply limited clear areas in the bone itself; it looks as if long chips had been taken out of the bone with a gouge. In the lower metaphysis the clear areas are less regular although of a similar character. The epiphyses do not seem to be affected.

In fig. 4, plate VIII, is shown a roentgenogram of the pelvis,

dating from the same time. Here the clear areas are found to be arranged in a rather regular fan shape in the squamous portion of the right iliac bone. In the right femur the part around the trochanter minor is especially affected; here the clear areas are spot-shaped; in the lower end of the femur stripes are to be found like those in the upper part of the tibia.

Nobody who has any knowledge whatever of that rare anomaly of the bones that has been called Ollier's disease can doubt that we have here a case of this sort.

Fig. 3, plate VIII shows a roentgenogram of the right crus taken during the patient's stay at our clinic, and thus taken 8 years later than Dr. KLUBIEN's photographs. The structural changes are less pronounced, the disease is evidently healing; but otherwise it will be seen that the clear areas have the same shape and the same extension as before; the characteristic features are the same. Evidently *no* »process« has taken place, by which some »foci« have vanished, while others have arisen somewhere else. In the photograph of the pelvis (not reproduced) the state is altered in a similar way.

In the foot (fig. 10, plate IX) only the first phalanx of the second toe is found to be affected; a couple of clear spots are found, however, in the first phalanx of the first toe, too.

I have further photographed all the bones of the patient, but — except for a singularity to be mentioned later — I have found no structural changes, nor abnormities anywhere else but in the above mentioned bones of the right lower extremity. In this respect the case differs from all cases published before, in which the disease always was found to exist both in the upper and in the lower extremities of one side. In some cases less extensive structural changes were found also in the other half of the body, and then mostly in the phalanges or the metacarpus or the metatarsus. At the congress of Orthopedists, held in Christiania in June 1922, where I reported this case for the first time, CHR. JOHANNESSEN, the Norwegian pediatrist, demonstrated another case, in which the upper extremities were normal, while both of the lower extremities were affected, the right one, however, much more than the left one.

Altogether I have been able to find 12 cases of Ollier's disease in the literature (NOVÉ-JOSSERAND 1, OLLIER and MOLIN 3 altogether, WITTECK 1, COON 1, KÖHLER 1, BURCHARDT 2, in Scandinavia, BOJESEN has published 1, SVEN JOHANSSON 1, besides CHR. JOHANNESSEN's case which has already been mentioned). When we suppose, as we may do, that most cases of this strange disease are published, if they are diagnosed, there can be no doubt but that the disease is a very rare one. Although these cases differ from each other in some ways,

it is possible, by the very characteristic Roentgen pictures of the affected bones, to learn that it is one and the same anomaly of growth, and one which may be easily distinguished from all other known diseases of the bones. The differences are mostly due to the very different degrees attained by the changes in the bone; where the changes are exceedingly great the characteristic order of the clear stripes and spots vanishes, while the bone is very much deformed (e. g. the humerus of Bojesen's patient). But a comparison of the bones, in which the disease has reached very nearly the same degree, will show a very striking similarity (fig. 6 and 8 plate IX).

Earlier reports have mostly consisted of casuistics, to which of course also have been added comments on the nature of the disease.

All are agreed, that the clear areas in the bone are due to the fact that the bone in those places has been superseded by cartilage; but it has been discussed whether this cartilage is to be regarded as enchondromes, i. e. as real tumors, or as nothing but an abnormal appearance of otherwise normal cartilage. FRANGENHEIM, who contended that they were enchondromes, protested against the classification of Ollier's disease as a separate disease, he regarded it as rather trivial cases of enchondromatosis principally localized to one half of the body. He wanted to see at least one case, in which the semilateralness was complete, to recognize it as a disease sui generis. Among the cases published, several cases of this sort are to be found; my case, also, belongs to this category.

SVEN JOHANSSON refutes FRANGENHEIM in his paper. He made an excision of pathological tissue for study from the lower end of the tibia. The result of the biopsy was as follows: »Das Periost unbedeutend verdickt, löst sich abnorm leicht ab. Der Knochen darunter in eine blauweiss, halbdurchsichtige Masse von knorpelartiger Konsistenz umgewandelt. Keine Abgrenzung nach oben zu und keine Andeutung einer Kapsel nach irgend einer Seite hin. Kein Knochenmark sichtbar.»

A piece of the periosteum was excised and some pathological tissue was scraped off for histological examination, the result being this: »Die Præparate bestehen zum grössten Teil aus hyalinem Knorpel mit typischen Zellen in einer homogenen Grundsubstanz; an ein paar Stellen Andeutung von schleimiger Degeneration der Grundsubstanz. An mehreren Stellen sieht man neugebildete Knochenbalken, wobei der Übergang zwischen Knochen und Knorpel durch osteoides Gewebe vermittelt wird, ohne dass in dieser Übergangszone die typische Anordnung bei Knochenbildung aus Knorpel nachgewiesen wird; vielmehr verlauft die Grenze launisch mit eingeschlossenen Knorpel- und Knocheninseln, die Zellen ohne typische Anordnung gelagert und ohne die serienmässig fortschreitende Ver-

änderung von Knorpel- zu Knochentypus. Die Knochenbalken begrenzen verhältnismässig grosse Markräume, Fettgewebe und Rundzellen enthaltend. An ein paar Stellen sieht man an der Grenze zwischen neugebildeten Knochen und Knorpel eine typische palisadenförmige Anordnung der Knorpelzellen, also Bilder wie bei der normalen, typischen Knochenbildung.»

From CHR. JOHANNESSEN's patient, too, a pathological tissue for study was taken (from the upper end of the tibia), where, too, the periosteum was found to be thickened, and abnormally easy to detach from the bone. Microscopic examination of a piece chiselled out of the cartilaginous mass gave this result: »Das Præparat besteht aus einem sehr zellreichen, hyalinen Knorpelgewebe, wo die Zellen ausserordentlich zahlreich, aber durchaus typisch sind. Hin und wieder sind feinere und stärkere Züge fibrinösen, zellarmen, teilweise hyalinen Bindegewebe zu sehen, die den Knorpel in grössere und kleinere Felder teilen. Keine Anzeichen einer atypischen Neubildung oder Entzündung.»

These microscopic findings agree rather well with one another and speak strongly against considering the cartilaginous masses true tumors. The clinical experiences showing the benign character of the disease point in the same direction.

But if those cartilaginous masses are not enchondromes, properly speaking, what then are they to be considered? That is the question which I am trying to answer in the following.

Two peculiarities in this disease have caught my special attention and constitute the basis of the hypothesis which I have formed as to its character, viz. the characteristic regular localization of the cartilaginous stripes in the bones affected and its pronounced tendency to semilateralness.

The very peculiar figure formed by the cartilaginous stripes must be due to some law governing their extension, as it is practically identical in the same bone of different patients. In figs. 6 and 8, plate IX, I have reproduced the roentgenogram of the crus of JOHANNESSEN's patient together with that of my patient. JOHANNESSEN's case is a good deal more serious than mine, but it is easy to recognize, that the place and number of the cartilaginous stripes are strikingly alike both in the upper and in the lower metaphysis. This phenomenon may be understood if we suppose that the place of the cartilaginous stripes correspond to the extension in the bone tissue of some normal-anatomical element. In this connection I turned my attention especially towards the ramifications of the arteries of the bone, and in order to see if there existed any relation between this and the figure of the cartilaginous stripes, I took roentgenograms

in profile of the bones affected in my patient. It ought to be remarked that I have found no side-views reproduced among the illustrations accompanying the cases of Ollier's disease previously published.

The side-view of the leg (fig. 11, plate X) instantly confirmed my supposition. It will be seen how the cartilaginous stripes of the upper metaphysis, which in the frontal picture form a regular fan shape, in this projection form a narrow band, which tends »unswervingly» downwards to the dorsal side of the bone towards the place of the nutrient foramen; and here is a considerable bump on the bone, its top lying a little proximal in relation to the lower end of the band. In the side-view of the femur (fig. 5, plate VIII) it is seen that the clear area in the lower metaphysis is also pointed towards the back of the bone about the foramina of the arteries, and, corresponding to those — the femur having two nutrient arteries — two small exostoses are found. The cartilaginous »fan» in the femur is here broken by the fracture mentioned above.

To be able to settle this question with more certainty, I tried to ascertain the normal course of the arteries in the diaphyses of the long bones. There is a *Thèse de Lyon* from 1894 by Marius Siraud, dealing with this question, but this monograph has no illustrations and is therefore not of much use. Best known is Lexer's work, which is based on roentgen-examinations of injected bones; most of Lexer's pictures are, however, of a half schematic type — they are drawings of the roentgenograms — which makes them less suitable for direct comparison with ordinary roentgenograms. I decided therefore to try and take a series of roentgenograms of this sort and for that purpose I approached Mr. Fr. Djørup, M. D., the then prosector of anatomy, who very kindly undertook to inject such material as could be procured. As to the material of grown up persons, this was so poor that the injections failed, but dr. Djørup obtained beautiful results with a foetus of 1100 gr.

In the plates IX & X I have reproduced the enlarged roentgenograms of some of the injected bones together with the roentgenograms of the affected bones of the patient.

The arteries of the pelvis branch like a star in the iliac bones. As to the femur, the injection in the upper metaphysis was incomplete, but it showed the two main arteries at their foramina and the descending, regularly wedgeshaped extension in the lower metaphysis, where the branches formed a figure that was seen to correspond quite well to the clear areas of the femur of the patient (the roentgenograms of the injected preparations of the pelvis and of the femur are not reproduced). In the front-view roentgenogram

of the crus (fig. 7, plate IX) a greater, more regular fan of vessels is found in the upper metaphysis, and a smaller and less regular one in the lower metaphysis, corresponding quite nicely to the extension of the clear areas.

The side-view roentgenogram of the tibia carries the most direct conviction; it shows how the nutrient artery runs obliquely downwards through the cortex and then gives off branches upward and downward. If we suppose, that the top of the abnormal bump on the tibia of the patient corresponds to the foramen of the artery — and, in the light of the *two* small exostoses on the back of the femur, this is almost justifiable, — the fan in the upper metaphysis of the patient will correspond rather well to the branches of the ascending artery, and the clear areas in the lower metaphysis will correspond to those of the descending artery.[1]

To make sure that this was not something specific to my patient, I made Dr. JOHANNESSEN take side-view roentgenograms of the leg of his patient, which showed similar conditions.

I think it may be considered proved that the pathological changes of the bones in Ollier's disease follow paths similar to those of the arteries of the bones. This does not prove, however, that the disease is due to anomalies in the arteries, for in the first place there is a chance that certain circumstances with regard to the normal architecture of the bones are responsible not only for the paths of the arteries, but also for the characteristic limitation of the disease, and in the second place there may be other anatomical elements — and first and foremost the nerves — that follow the same paths as the arteries, and may thus equally well be associated with the disease.[2]

Without going further into this problem I turned to the other characteristic of the disease, viz. its tendency to unilateralness, which justifies a close observation of the nervous system. Would it not be possible that we had to deal with a neurotrophic disease? In that case it might be supposed that pathological conditions in the sympathetic (vegetative) nervous system were the cause of the disease. Various circumstances to be mentioned further on made me believe so much in this hypothesis that I resolved to test ist worth.

[1] By measuring 20 tibiæ DAX found an average length of the bone of 36.1 cm. and an average distance from the upper end of the bone to the nutrient foramen of 13,5 cm. The right tibia of my patient is 32,2 cm. long (in the roentgenogram) and the place on the bone, that is supposed to correspond above to the foramen of the artery, is 10,8 cm. distant from its upper end, which agrees rather well with the statements of DAX.

[2] With regard to the innervation of the bones MAAS writes: »Zahlreiche Nervenstämchen begleiten die Arterien, es sind die Verzweigungen eines Stammes, *der mit der arteria nutritia* in das Knochenmark eintritt.»

Examining my patient for other symptoms of an affection of the sympathetic nervous system I find her pilomotors reacting in a normal manner and with equal strength in either half of the body, also the capillaries of the skin. There is no inequality of the pupils; but her face is quite distinctly asymmetrical; first of all she has a rather pronounced dextroconvex cranial scoliosis, but there is further a slight atrophia of the right half of the face, seen most distinctly in the wing of the nose. Such a hemiatrophia of the face is a well known symptom of affections of the sympathetic ganglia around the apertura thoracis superior, and it is often seen in patients with obstetrical lesions of the brachial plexus, in whom the rami communicantes between the sympathetic ganglia and the nerve roots forming the plexus often are injured coincidentally with the plexus itself.

This symptom — hemiatrophia of the face on the same side as that where the disorders of growth are found — has been observed in three of the cases already published of Ollier's disease, namely, in one of MOLIN's patients, and in BOJESEN's and JOHANNESSEN's patients. I may mention in this connection that JOHANNESSEN's patient suffered from a psoriasis; but apart from this I have not found in the cases published any secondary symptoms indicating an affection of the sympathetic nervous system.

During the systematic Roentgen-examination of the skeleton of my patient I paid especial attention to the examination of her spinal column. I admit it was quite improbable that a possible anomaly of the sympathetic cord would be of the kind that would show itself in a roentgenogram. If these researches of mine do ever yield a result, it will be thanks to a coincidence — I dare not call it anything else — coming to my aid. The 2. dorsal vertebra of my patient showed a peculiar anomaly. As will be seen from fig. 9, plate IX, the body of this vertebra seems to be pushed somewhat out of place, its right side being considerably lower than its left side. I cannot say for certain how this picture is to be interpreted, and *now* I dare not contend that there is any connection between this phenomenon and the disease of the patient; but at one time I supposed it was so. I imagined a chain of cause and effect, thinking that the patient in her earliest childhood had once had a trauma (in her anamnesis no information could be gathered as to any such thing, however), which might have been the cause of a fracture or luxation of this vertebra — the roentgenogram resembles nothing so much as it resembles a traumatic affection — which, again, might have been the cause of a lesion of the sympathetic cord, which in its turn might have been the cause of the disorder of growth.

On the basis of this hypothesis — the fallibility of which I have always been well aware of — I planned the animal experiments which I have made in the Laboratory of Animal Physiology of the Royal College of Agriculture in Copenhagen during the last two years.

My intention was — briefly — to try if it were possible by injuring one of the sympathetic cords of a growing animal at the level of the upper dorsal segments to produce disorders of the growth of bones, similar to those seen in Ollier's disease.

All my experiments have been made on young rabbits, which I hold, for several reasons, to be especially suitable for this purpose. They grow quickly, they are not so small that the operation becomes technically impossible, and yet not so large as to render insurmountable the costs of the ever repeated roentgenopraphy; it is also of importance that it is exceedingly easy to make a rabbit lie still during the exposures. (Out of the 3—400 roentgenograms of living rabbits taken by me hardly more than two or three have failed because of the animal having stirred.)

My first experiment was limited to gaining access to the side of the spinal column of a young rabbit of 43 days by resecting a piece of one of the upper ribs and then severing the sympathetic cord by means of a small hook. I soon realized, however, that this method would yield no results. From the view I had taken of the nature of the disease, I must surmise that I had to injure principally the vasomotor nerves of the extremities. I have not been able to find in the more recent textbooks and encyclopædias of the sympathetic nervous system (W. H. Gaskell, L. R. Müller) any precise information as to the course of these nerves. In a paper from 1894, Bailys and Bradford state that the portion of the sympathetic cord containing these nerves is very extensive; those investigators were able to influence the vessels of the extremities by irritating the rami communicantes from the second dorsal to the third lumbar segment (in dogs).

I had then to take into account that, in order to influence the innervation of the vessels, it would be necessary to destroy the sympathetic cord to a great extent. I gave up trying to do this by a simple mechanical injury and began to use this method: I inserted a fine morphia needle between two ribs about their angles (somewhat medial to the scapula); the point was carried in a ventral and medial direction until it was stopped by the side of the column (the vertebral bodies); then I injected up to $^1/_3$ of a c. c. of absolute alcohol. By using needles ground at a very obtuse angle I made the alcohol form a sort of »bulla» in the loose connective tissue

between the pleura and the wall of the thorax. In fig. 22 I have illustrated the method by injecting chinese ink instead of alcohol into a preparation.

In this way I succeeded in swamping the sympathetic cord with alcohol to a great extent, even if the point of the needle missed the cord itself. The method was not quite infallible; the animals were rather small, and consequently the side of the vertebral body to be reached by the needle point was narrow; as it had to be done by touch at a rather great depth, the injection happened a few times to strike too far back, by which the alcohol penetrated into the spinal canal. In these cases there resulted a paraparesis of the lower half of the animal which was then killed at once. When the injections succeeded, the general health of the rabbit did not seem to be affected.

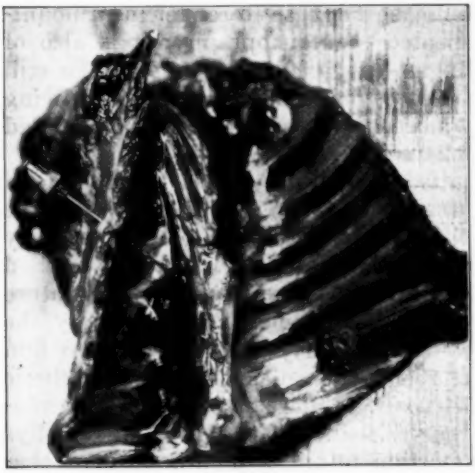

Fig. 22.

In this way I have treated 30 young rabbits from 20 to 60 days old; some have had only one injection, in others I have either injected the alcohol in several places at different heights, or given several injections at intervals of some days.

As a test that I had really influenced the sympathetic cord (or at any rate the rami communicantes) I got two symptoms: a narrowing of the pupil of the same side and a dilatation of the vessels in the ear of the same side (fig. 17, plate XI). Of these symptoms the narrowing of the pupil did not always occur, even though the dilatation of the vessels set in, while the latter always occurred when a myosis was found. The probable explanation of this is, that the nerves leading to the vessels of the head in rabbits (as in man) are to be found in a lower segment than the nerves that dilate the pupils, and are thus more exposed to the alcohol. In the cases in which a narrowing of the pupil occurred, it persisted for a long time, mostly for the rest of the life of the rabbit. The dilatation of the vessels, on the other hand, had a very variable duration, from one or two days to a couple of months.

Of the 30 young animals three died or were killed directly after

the operation on account of the effect of the alcohol on the spinal cord, of the remaining 27 ones 19 had dilatation of the vessels of the ear, 13 had narrowing of the pupil.

As soon as the dilatation of the vessels of the ear had persisted for 4—5 days, I could make out an increased rate of growth in the ear which grew longer than the other one. I think I have proved beyond doubt that this quicker growth is dependent upon the dilatation of the vessels. It occurred only where the latter was found, and when the vessels of the two ears were equal once more, the difference in length very soon disappeared. Even in the cases, in which the dilatation of the vessels had persisted for two or three months, the difference in length was later on balanced completely, so that the rabbits, when they were grown up, had both of their ears equally long.

In one single rabbit (experiment ledger D. I, fig. 18, plate XI) the difference in length of the ears amounted to 14 mm. at its highest (about 1 month after injection). The greatest difference in the others amounted to 8—9 mm, in most of them to 3—4 mm only.

When I took roentgenograms of the thorax of the rabbits some weeks after the injections of alcohol I sometimes found fairly extensive osseous deposits on the ribs, corresponding to the injection. From this I could form an opinion as to the extension of the injury to the sympathetic cord. In this respect, too, the rabbit D. I showed the gravest and most extensive changes, such deposits being found on 7 ribs (III—IX) (fig. 16, plate XI). Yet this rabbit had had only one injection of alcohol. None of the others had deposits on more than five ribs, even if they had been given as much as 8 injections at different heights.

In a denuded specimen these exostoses on the ribs are found to be a cancellous tissue rather poor in lime. I take it, that it is the directly irritating effect of the alcohol on the periosteum that is the cause of this reactive new formation of bone.

A few weeks having elapsed after the injection, I took roentgenograms of the extremities of the rabbits, which I repeated at intervals of about 14 days during the following months. In all cases save one I found then an altogether normal skeleton. The exception was once more rabbit D. I, who had shown the greatest reaction in other respects as well.

One month after the injection I found in this rabbit gross osseous changes in the first phalanx of the second toe of the forepaw on the same side where the injection had been given. As will be seen in fig. 19, plate XI, the bone is very much thickened and several fairly well circumscribed clear spots are found in the tissue

of the bone. These anomalies show a striking similarity to those found in the phalanges of patients suffering from Ollier's disease. In the same plate I have shown, for the purpose of comparison, the roentgenogram of the hand of BOJESEN's patient (fig. 20).

Had I succeeded in getting a similar result just once more, I should have taken it for granted that Ollier's disease is due to a disorder in the innervation of the vessels. I have not succeeded, however, in making the phenomenon repeat itself and I must confine myself to express what I think may be inferred from this single case.

I might be asked why only this single bone was affected, although probably every single vasomotor nerve to the extremity had been injured; but this tendency to a local affection of a single bone is found in Ollier's disease as well. In my patient, for instance, only one bone of the foot was affected (and that, too, was the first phalanx of the second toe).

As long as only one positive result of the experiments has been obtained, the possibility is not precluded, however, that this result may be due to mere chance — that the pathologic changes of the bone are not due to the lesion of the sympathetic nervous system at all. But in assuming this, we have to ask what sort of changes these may be supposed to be. The changes are considerable and quite characteristic, and considering the great number of roentgenograms of rabbits' paws [1] that I have taken without ever finding any trace of anomalies in the form or in the structure of the bone, I venture to say that this is no common phenomenon in rabbits.

In order to follow the further development of the process and to wait and see if possibly other changes would appear in other bones, I let the rabbit D. I live till it was 5 months old. During this time the changes in the structure of the bone decreased so much that the bone, when the rabbit was killed, showed only a still considerable thickness, but the clear areas had almost quite disappeared.

Prosector GREGERSEN very kindly examined the bone microscopically together with the corresponding phalanx of the other paw, in order to compare the two. The affected bone showed: 1) a considerable enlargement of the marrow cavity and 2) a cortex of a coarser structure, showing a more osteoid type than that of the normal bone. There was no trace of inflammation of any sort, no necrosis, and no proliferation or infiltration of leukocytes.

No islands of cartilage were found under the microscope, but then the clear spots which ought to have shown such islands in the

[1] I have examined 186 extremities of 61 rabbits of various ages, photographing the rabbits from 1 to 6 times during the first year of their life, altogether about 400 photographs of extremities, representing about 5000 photographs of phalanges.

roentgenogram, had vanished before the microscopic examination was made. Judging from my later investigations (see below, pag. 107) it was to be expected that the cartilaginous tissue by now had been turned into osseous tissue long ago.

It would hardly be right — especially in the light of my further experiments — to deny altogether the probability of this affection having really been caused by the injury to the sympathetic nervous system. Otherwise it would be necessary to suppose it was a very curious coincidence of the rabbit having a disease of the bone that yielded a roentgenogram quite similar to that of Ollier's disease but was caused by some infection (spina ventosa?), or that it was a case of real tumour. The course of the disease and the microscopic findings speak very strongly, however, against these suppositions.

During the further experiments with injections of alcohol round the sympathetic cord I came to the conclusion that the injury to the innervation of the vessels was not extensive and lasting enough as compared with that produced in the rabbit D. I. The experiments of giving several injections along the length of the sympathetic cord did not improve the results. I also tried to add to the alcohol certain substances, supposed to be more injurious to the nervous tissue (20 per cent. of terpentine, 5 per cent. of formaline, 5 per cent. of chloroform), I even tried to substitute for the alcohol a 20 per cent. aqueous solution of hydroxide of sodium, but I did not obtain a stronger or more lasting effect than I did with alcohol.

On the advice of the then assistant of the laboratory, Mr. Dyssegaard V. S., I gave up using injections and tried to destroy the sympathetic cord directly after gaining access to it through pleurotomy. I did this in the manner formerly employed by Professor Møllgaard in operations on the lungs. It consists in splitting an intercostal space wide open and then forcing the adjoining ribs apart by means of a dilator. In this way it is possible by use of a head lamp to get a good view of a greater portion of the side of the thoracic spine.

The rabbits were from 31 to 60 days old when the operation was performed; this was done under ether anesthesia. Not all of them could stand the operation of opening the thorax, and a few of them collapsed and died during the operation. It was necessary, then, to see to it that the thorax was open only for a very short time. As it proved impossible to dissect away the sympathetic cord and to exstirpate it, I just burnt it away by means of a red hot iron wire, which took only a few seconds to do, so that the thorax was open only for about one minute. In this way I succeeded in destroying the sympathetic cord altogether for a length of 8 segments.

The operation was performed on 14 rabbits, in 8 of them on the left side, and in 6, on the right side. Five of the animals died within the first 24 hours after the operation. It is hardly to be wondered that they could not stand the narcosis and the rather extensive operation; but it is probable that also the intended interruption of the nerves of the sympathetic nervous system has in itself contributed to the death. At any rate, the most extensive destructions of the sympathetic cord (7—8 segments) were found in the animals that died shortly after the operation. The dorsal segments from the second to the eleventh were injured, so that many nerves to the viscera were also inevitably destroyed together with the nerves of the vessels to the extremities.

In all the animals a great dilatation of the vessels of the ear occurred on the same side, but none of them showed inequality of the pupils. The dilatation of the vessels of the ear was, however, of a shorter duration than that found in the animals treated with alcohol. In one single rabbit (P. II) it persisted for 20 days, of the other 8 that lived at the end of the first 24 hours after the operation the dilatation disappeared in 4 within 24 hours, in 2, within 48 hours, in 1 it persisted for 3 days, and in 1 for 5 days. In the case, in which the dilatation lasted for 20 days, the ear in question grew a little (2—3 mm.) longer than the other.

The extremities of the rabbits were photographed at intervals of some weeks during the first months following the operation (6 of the animals lived for more than 40 days subsequent to the operation); but no demonstrable anomalies of the skeleton appeared. The experiments did not yield the desired result, yet they gave me some valuable information. Taking into consideration the technique I used, I could hardly believe that the sympathetic cord was not thoroughly destroyed as far as the cauterization had reached. When the vessels regained their tonus this could hardly be due to the destroyed ganglia of the sympathetic cord resuming their function. To make sure that this really did not happen, I performed the operation twice on the same rabbit at an interval of 10 days. The dilatation of the vessels of the ear disappeared during the second day after the first operation and did not reappear after the following operation, when I burnt away once more all the cicatrical tissue from the first cauterization.

In this way I made sure that it must be the peripheral ganglia which assume the function of the ganglia of the sympathetic cord and restore the tonus of the vessels.

The experiments gave another important piece of information. In the four last animals I operated on, I took the temperature of

the ears, the forelegs and the hindlegs shortly after the operation; and I found in all four cases that it was somewhat higher (0,6—1,5° C.) on the side where the operation had been performed. Surely, this rise in temperature can be due only to the increased flow of blood produced by the paralysis of the nerves of the vessels. It is quite consistent with BAILY'S and BRADFORD'S description of the course of those nerves, that the difference of temperature in the lower extremities is like that of the upper extremities.

The power of the peripheral ganglia to assume the function of the ganglia of the sympathetic cord is an altogether incalculable factor and seems able to preclude the possibility of a positive result of the experiments in most cases; I have therefore — at any rate for the present — given up injuring the sympathetic cord itself and have instead tried to cut off the innervation of the vessels in individual bones by operating on their nutrient arteries. Before speaking of the results of this series of experiments I have to render an account of my views of the causal connection between an eventual paralysis of the vasomotor nerves and the pathological changes in the bone tissue.

As will be understood from the preceding, I have formed a hypothesis as to the pathogenesis of the disease in question, which may be expressed in this way:

Ollier's disease represents the typical reaction of the bones against certain disorders in the innervation of their blood vessels.

Let it be clearly stated, that I have confined myself in this work to try and prove the connection between this disease and anomalies of the vegetative nervous system; the cause of these anomalies, i. e. the etiology of the disease, I shall not try to explain; in the early and most serious cases one would be most inclined to presume a congenital aplasia of the nerve elements.

I assume that the disorder of the innervation of the vessels is of the sort that produces a paresis of the muscles of the vessels, with vascular dilatation and an increased circulation of blood. If such a tendency towards an abnormally increased circulation of blood be found in the extremities affected, and if this be able to cause disorder in the growth of the tissue, it would seem probable, a priori, that these disturbances might appear in the other parts of the extremity just as well as in the bone tissue. Yet, it is not improbable that the osseous tissue may be more sensitive to irregularities of this sort than other tissues; because the muscles, the skin, the glands, being active, regulating, producing tissues, demand a very much varied supply of blood, whereas the osseous tissue, being a supporting tissue only, which therefore has a more vegeta-

tive existence and only demands to be nourished, renewed and — in young individuals — to grow, will necessarily be adapted to a more uniform consumption of nourishment and therefore probably receives a constant amount of blood per unit of time. In 1876 LANGER published some researches as to the blood vessels of the long bones. He states that it is possible to conclude from the very scarce provision of arteries, as compared with the numerous, mostly sinus-like, distended veins, that the circulation of blood through the bone tissue is very slow. It is therefore not unthinkable that disorders in growth are more likely to happen to the bone tissue, if it is exposed to an abnormal engorging with blood, than to other tissues which, on account of their function, have got »accustomed» to receiving a very varying supply of blood.

The nerves of the sympathetic nervous system reach the extremities by two roads. The nerves of the cutaneous vessels and of the pilomotors run back from the ganglion of the sympathetic cord to the spinal nerves and follow these out into the extremities, while the nerves to the blood vessels of the deep tissues — muscles, bones &c. — follow the arteries. The first system forms a physiological unit as an important factor in the regulation of the body temperature and must be supposed to be regulated independent of the rest of the innervation of vessels.[1]

But, even if we suppose that in Ollier's disease disorders are found only in the part of the innervation of the blood vessels that follows the arteries, and even if we agree with the line of arguments according to which the increased circulation of blood would affect especially the osseous tissue, it is not evident why not *all* osseous tissue of the extremity shows the characteristic anomaly of growth. For Ollier's disease never affects all the bones of an extremity, as it is only found in the diaphyses of the long bones, apparently never in the epiphyses or in the short bones of the carpus and tarsus, and it very seldom attacks the diaphyses of all the long bones.

This may be supposed to be due to an irregular distribution of the peripheral ganglia, which in some places are able to undertake the regulating of the innervation of the vessels, when the central regulation has failed, but which are not able to do this in other parts. (I am not able to form an opinion as to the importance of

[1] In this connection I would like to call the attention to the very peculiar disease called congenital local gigantism, the most conspicuous symptoms of which are extensive dilatations of the cutaneous blood vessels (naevi vasculosi) and a great increase of the subcutaneous adipose tissue. This is very likely a »trophical disorder» caused by anomalies of the superficial parts of the vegetative nervous system. It is then, so to speak, analogous to OLLIER'S disease, as interpreted by me.

this circumstance to any greater extent than shown in the preceding experiments). If the roentgenograms of the diseased bones of the patients are studied, it will be seen that the disease is mostly found where the bone tissue is supplied with blood by a single large nutrient artery. This phenomenon has suggested to me the idea that the degree of hyperfluxion is of primary importance, that is, that the anomaly of growth does not set in until the hyperfluxion has reached a certain height. To me this seems to be the only likely explanation of the fact that the disorder of growth (the stripes of cartilage) branches out into the bone tissue as a sort of »delta» from the large nutrient arteries.

All these arguments, however, do not have any firm foundation as long as no likely reason has been given why a hyperfluxion in the osseous tissue should induce this to form *cartilaginous tissue.*

Under which circumstances is cartilaginous tissue formed by the diaphyses of the long bones? Well, this is a common enough phenomenon. It happens whenever a solution of continuity in the osseous tissue is repaired by *callus formation.*

When a bone is fractured, vessels in the osseous tissue, in the marrow and in the periosteum are torn, by which a large or small haematoma is formed at the site of the fracture. It must be regarded as inevitable that the direct consequence of the fracture will be a diminished circulation and nutrition in the adjacent tissues, but very soon after the fracture, already during the first 24 hours, the process of healing sets in, preceded by an inflammatory reaction in the contused and blood-imbibed tissue round the site of the fracture, which becomes the seat of an active hyperaemia. During this period a lively resorption begins of the osseous tissue from the walls of the Haversian canals, the lumina of which become considerably increased.

On about the 5th day in animals and on the 8th day in man the formation of cartilage begins at the site of the fracture, obviously originating from the deepest parts of the periosteum. There has been some difference of opinions as to whether the marrow and bony tissue itself (the walls of the Haversian canals) conduce to the formation of hyaline cartilaginous callus. The dominating influence of the periosteum seems to be indisputable, but it cannot be considered proved that the other elements are altogether inactive.

Which one of the abnormal circumstances arising at the site of the fracture is the cause of this puzzling and sudden appearance of great masses of hyaline cartilage in places where this tissue under normal conditions cannot be traced at all? Although this problem is of the greatest interest to my investigations I have been unable

to find any references to it in the literature on bone regeneration that I have had the opportunity of going through — a somewhat restricted part, to be sure, of the extensive literature on this subject.

If the hyperfluxion be of importance in this respect, surely it is not unreasonable to assume that an abnormal active hyperaemia arising and continuing in the bony tissue may start processes similar to those producing the callus, even if there be no solution of continuity in the bone.

My last series of experiments, which will be described in the following pages, is meant to answer these questions.

If an active hyperaemia is produced in a bone through the interruption of the nerves belonging to the blood vessels at their entrance into the nutrient foramen, will this give rise to pathological processes in the bone, by which hyaline cartilage is formed?

Will these cartilaginous masses, if they are formed, appear in places similar to those where the cartilaginous stripes appear in Ollier's disease?

A peripheral sympathectomy performed on the nutrient artery after the method of LERICHE would be the most elegant way of producing an active hyperaemia in the bone tissue. In this operation the adventitia of the vessels in which the sympathetic nerves are found, is exstirpated to a certain extent. The operation must, however, be held to be technically impossible to perform on the very slender arteries of the young rabbits.

I had, then, to choose a more simple technique. By injecting a little alcohol around the main artery of the ear at the root of the latter on 4 young rabbits I have convinced myself that in this way a strong hyperaemia of the ear is produced. This hyperaemia persisted for 15—20 days. There can be no doubt but that this hyperaemia is due to the interruption by the alcohol of the conducting power of the nerves of the vessels here just as in the injections around the sympathetic cord. I inferred that I would be able to produce in the same way an active hyperaemia in the bony tissue by injecting alcohol around the nutrient artery. I chose to operate on the crus, because the nutrient foramina of the tibia and fibula are easy to reach, and they may be found by palpation without any difficulty, as they are situated a little proximal to the junction of the two bones (see fig. 13, plate X, which shows the crus of a normal rabbit, into the arteries of which cinnabar-gelatine has been injected by dr. DJØRUP).

The experiment was tried on 23 young rabbits from 40 to 60 days old, but only two of these 23 experiments yielded results that came up to the expectations I entertained of the experiments. Be-

fore describing these positive results I will mention some of the technical difficulties that have been the cause why so many of my experiments have yielded negative results or at any rate have yielded no results that might be regarded as conclusive.

When injecting, I gave such a direction to the needle that I was sure not to injure the wall of the artery itself, as this might have produced a closing of the lumen. The injection of alcohol came thus a little to the side of the artery, and it depended to a great deal on luck whether it spread in the tissue in such a way as to entirely surround the artery. When I took roentgenograms of the crura after injection I found that during the first 10 days or so some more or less extensive periosteal bony deposits were formed, corresponding to the extension of the alcohol injection (resembling the deposits formed on the ribs by the injections around the sympathetic cord). When later on the animals were killed and the crura skeletonized, I was able to judge by the extension of these deposits whether the alcohol had reached the artery or not. In most cases the artery had clearly not been reached by the injection and in these cases I found nothing abnormal in the bone, apart from the periostal deposits mentioned above. In other cases, in which it was seen at a later examination that the artery had been reached by the injection, I found, by the roentgenograms, beside the periosteal deposits at the site of injection, that there were also structural changes in the bony tissue at a greater distance from the injection, either in the upper metaphysis of the tibia or in the fibula.

These structural changes appeared in the tibia as longitudinal clear bands, resembling those in Ollier's disease, but as a rule they disappeared quickly, persisting only for about a week. This made it difficult for me during my first experiments to find out the proper time for killing the rabbit in order to establish by microscopy that there really was hyaline cartilage present in the bone, corresponding to the clear bands in the roentgenogram. For instance the rabbit K. II, which exhibited characteristic bands in the tibia and irregularities in the shape and structure of the fibula already 14 days after the injection, was not killed before 56 days had elapsed after the injection. Under the microscope only some rather scarce hyaline cartilage was found in the fibula near its junction with the tibia. Some time before that there must have been much more cartilage, which by now had been turned into bony tissue once more.

But it is not of any great interest in an experiment of this sort to enumerate the operations which, owing to technical difficulties, do not yield any results at all, or, at any rate, any really convincing results. The conclusive point is to know whether any case did

really give an unmistakable answer to the questions raised on pag. 106; and that I think I have got in two cases, which I will describe in detail:

Rabbit R. II, born $^{21}/_{1}$/1923.

$^{24}/_{2}$. One quarter of a c. c. of 96 per cent. alcohol was injected near the junction of the bones in the left crus.

$^{9}/_{3}$. Roentgenograms of crura show nothing abnormal.

$^{13}/_{3}$. Another injection of alcohol near the nutrient artery of the tibia left.

$^{27}/_{3}$. Roentgenograms now show rather extensive periosteal bony excrescences on the tibia at the site of injection, and above their upper limit in the metaphysis of the tibia some laterally well-defined, band-shaped, longitudinal clear areas are seen in the bony tissue.

$^{4}/_{4}$. The roentgenogram shows the stripes mentioned above still more distinctly (Fig. 14, plate X).

$^{5}/_{4}$. The rabbit is killed. Immediately afterwards the lower extremities are injected from the abdominal aorta with 250 c. c. of cinnabar-gelatine solution (Dr. DJORUP). When the crura are skeletonized it is found by measuring that the left tibia is 1,5 mm. shorter than the right one. The roentgenograms of the skeletonized bones show a regular course of the arteries in both crura; but *no vessels* are seen where the clear bands are found in the bony tissue of the upper metaphysis of the left tibia.

Fig. 15, plate X shows an ordinary photograph of the crura; the periosteal, bony deposit corresponding to the extension of the alcohol is set off by a lighter colour than that of the rest of the bony tissue, it fills up the space between the tibia and the lower half of the fibula. The place on the bone that corresponds to the clear areas seen in the roentgenogram is found proximal to the upper limit of the periosteal deposit. Here the bony tissue is superseded by a soft tissue of a darker colour, through which a needle is easily passed into the marrow. This tissue is clearly cartilage, but this has not been verified by microscopy, for in this case it is of even greater interest that the structural changes, as shown by the skiagram, show a very marked resemblance to those found in Ollier's disease (Fig. 14, plate X), and thefore I wanted to keep the bone intact.

Rabbit C. III, born $^{25}/_{6}$/23.

$^{5}/_{8}$. One quarter of a c. c. of 96 per cent. alcohol was injected near the junction of the bones in the right crus.

$^{13}/_{8}$. Roentgenogram shows nothing abnormal.

$^{25}/_{8}$. Roentgenogram shows some not very extensive periosteal deposits on the tibia close by the site of the injection. No structural changes of the bones are seen.

$^{7}/_{9}$. Another injection of one quarter of a c. c. of 96 per cent. alcohol near the junction of the bones.

$^{21}/_{9}$. Roentgenogram now shows great periosteal deposits on the tibia and the fibula near their distal ends. Besides, the fibula is considerably (4 mm.) shortened and is the seat of structural changes which show clear areas in the bony tissue, and reach almost to the epiphyseal line (Fig. 21, plate XII).

$^{26}/_{9}$. The rabbit is killed. The crura are microscopically examined. In fig. 21, plate XII, are seen some cross sections of the bone under low magnifying power, very kindly prepared for me by Dr. O. HORRING.

Section I is taken proximal to the epiphyseal line of the fibula (through the small fabella (a) of the external gastrocnemius). In this section there is nothing abnormal to be found.

Section II cuts the epiphyseal line (b), and this, too, shows normal conditions.

Section III lies a little distal to the epiphyseal line and shows a normal cortex over the whole circumference of the fibula, so that it is quite certain that there is no connection between the cartilage of the epiphysis and *the great mass of cartilage* (c) seen in section IV, which mass extends through the entire cortex of the fibula and bulges far out into the surrounding tissues. This section (IV) cuts through the upper parts of the periosteal deposits on the tibia (d), but the cartilaginous mass in the fibula has no connection with those. In the more distal sections V (which cuts through the nutrient canal of the tibia) and VI it is seen how the periosteal doposits envelop the greater part of the back of the bones. Here and there in these bony neoformations are found islands of hyaline cartilage (e).

In this rabbit it must be supposed that it is especially the nutrient artery of the fibula (see fig. 13, F, plate X) that has been effected by the alcohol.

The final conclusion from my experiments must be this:

Ollier's disease may be interpreted as the typical reaction of the bones against an active hyperaemia of the bone tissue, arising owing to anomalies in the vegetative nervous system.

The pathological processes in the bony tissue may be assumed to be related to the phenomena seen in the formation of callus.

I do not think, however, that I have given irrefutable proofs of the truth of this supposition. This would require far more experiments than I, who am a clinician, could undertake. But I hope that my attempt to gain a deeper understanding of this interesting and hitherto quite puzzling disease will arouse the interest of others, for

I believe that a full inquiry into the nature of this rare disease might throw a new light on several hitherto dark points in the question of the growth and regeneration of the bones.

In the present paper I have stated only my own personal opinion of Ollier's disease and the results of my investigations, and I have refrained from referring to previous works on this subject. Those of my readers who are acquainted with these works, will see that my idea of this disease is quite different to the views that have hitherto been advanced, indeed, it is so different that I have not considered it of any use to discuss the probabilities of the previous interpretations. Here, towards the end, however, I wish to state that I agree with the authors who regard Ollier's disease as a disease sui generis, without any connection with the malignant progressive chondromatosis, to which FRANGENHEIM counts it. But, on the other hand, it will be understood that I disagree with OLLIER and WITTEK who describe the disease as a disturbance of the epiphyseal growth. I regard the impediment to the epiphyseal growth as a secondary phenomenon, the primary focus of the disease being the diaphyses, especially those parts of the bones, which are nourished by a single large nutrient artery.

During the preparation of this work I have received help from several colleagues; Dr. KLUBIEN, Dr. BOJESEN and Dr. CHR. JOHANNESSEN have lent me their roentgenograms, the prosectors GREGERSEN and STAMER and Dr. O. HØRRING have done the microscopic work for me. Dr. DJØRUP has made the injections into the vessels of the bones, in such cases where it has been necessary, and Mr. DYSSEGAARD, V. S., has helped me in my operations. I want them all to accept my warmest thanks.

An especially great debt of gratitude I owe the Chief of the Laboratory of Animal Physiology of the »Royal College of Agriculture», Professor MØLLGAARD, for the excellent working conditions he has provided for my animal experiments in his laboratory, and also for much good advice.

Finally I want to thank Professor SLOMANN for his stimulating encouragement during my work and for his sober criticism.

SUMMARY. The author regards the dyschondroplasia (Ollier's disease) as a neurotrophic disorder of the bony tissue owing to anomalies in the innervation of the vessels of the bones. This view of the subject is chiefly based upon the following facts:

1) The disease is very often confined to one half of the body.

2) The pathological changes in the bony tissue, viz. the masses of hyaline cartilage, are found to follow paths similar to those of the arteries of the bones.

3) By interrupting the nerves to the vessels in animals (rabbits) the author has in some cases been able to produce changes in the bony tissue, resembling the structural changes seen in Ollier's disease.

The pathological processes in the bony tissue may be assumed to be related to the phenomena seen in the formation of callus.

ZUSAMMENFASSUNG. Der Autor betrachtet die Dyschondroplasie (Olliersche Krankheit) als eine neurotrophische Störung des Knochengewebes, beruhend auf Anomalien in der Innervasion der Knochengefässe. Diese Anschauungsweise gründet sich hauptsächlich auf folgende Tatsachen:

1) Die Krankheit ist sehr oft auf eine Körperhälfte beschränkt.

2) Die pathologischen Veränderungen im Knochengewebe, bzw. die Massen von hyalinem Knorpel haben, wie sich gezeigt hat, in ihrer Lokalisation einen ähnlichen Verlauf wie die Arterien der Knochen.

3) Durch Unterbrechung der Gefässnerven war Verf. bei Tieren (Kaninchen) imstande in einigen Fällen Veränderungen im Knochengewebe hervorzurufen, die den bei der Olliershen Krankheit beobachteten strukturellen Veränderungen ähnelten.

Man kann annehmen, dass die pathologischen Prozesse im Knochengewebe den Phänomenen verwandt sind, die man bei der Kallusbildung beobachtet.

RÉSUMÉ. L'auteur considère la dyschondroplasie (la maladie d'Ollier) comme une affection neurotrophique du tissu osseux due à des anomalies dans l'innervation des vaisseaux des os. Son opinion est basée principalement sur les faits suivants:

1) La maladie est très souvent unilatérale;

2) Il a trouvé que des altérations pathologiques du tissu osseux, à savoir la formation de masses de cartilage hyalin, suivent des trajets pareils à ceux qui suivent les artères dans l'os;

3) en détruisant chez des animaux (lapins) des nerfs innervant des vaisseaux, l'auteur a réussi de produire dans quelques cas des altérations dans le tissu osseux qui ressemblent aux altérations structurales observées dans la maladie d'Ollier.

On peut supposer que les processus pathologiques dans le tissu osseux sont apparentés aux phénomènes observés dans la formation du cal.

RESUMEN. El autor considera la dyschondroplasia (la enfermedad de Ollier) como una afección neurotrófica del tejido óseo debida a ciertas anomalías en la inervación de los canales de los huesos. Su opinión está basada principalmente en los hechos siguientes:

1) La enfermedad es muy a menudo unilateral;

2) El autor ha encontrado alteraciones patológicas del tejido óseo, es decir, la formación de masas de cartílagos transparentes, siguiendo trayectorias semejantes a las que siguen las arterias en los huesos;

3) Destruyendo en los animales (conejos) los nervios correspondientes a los canales, el autor ha lograd o producir en algunos casos alteraciones en el tejido óseo parecidas a las alteraciones estructurales observadas en la enfermedad de Ollier.

Puede suponerse que los procesos patológicos en el tejido óseo están emparentados con los fenómenos observados en la formación de la cal.

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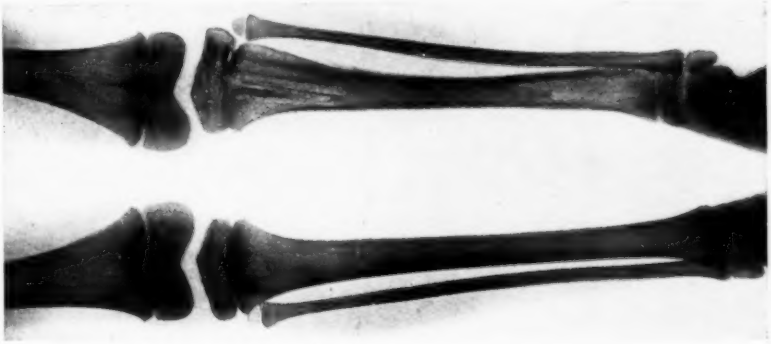
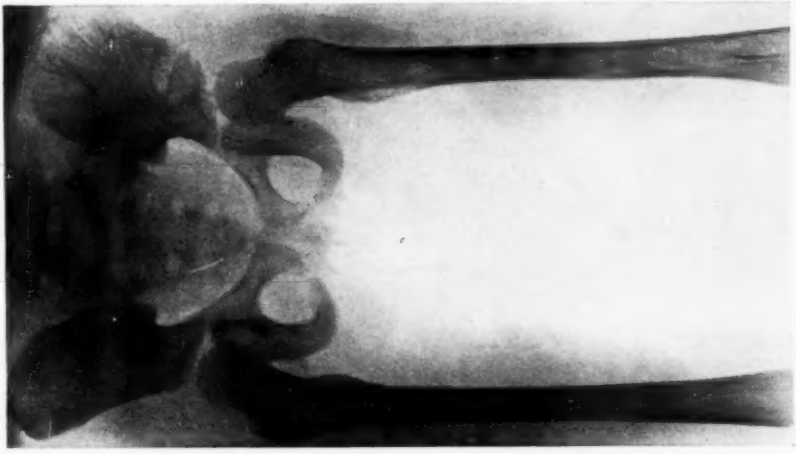


Fig. 2.

Fig. 3.



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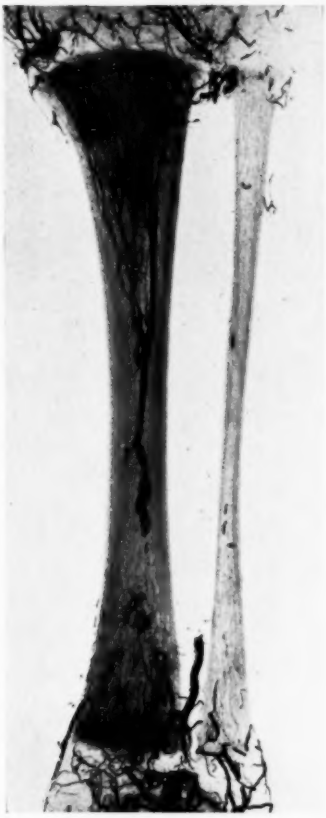

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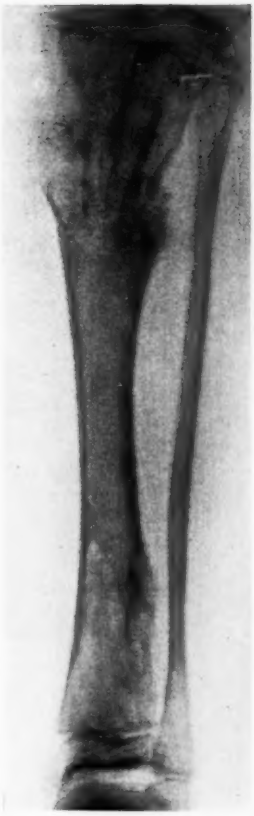

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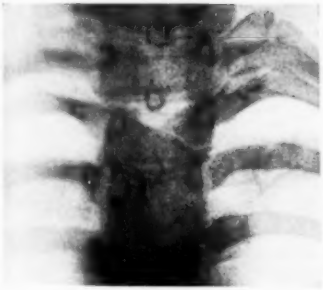

L. Fig. 9. R.

R. Fig. 10. L

Fig. 11.

Fig. 12.

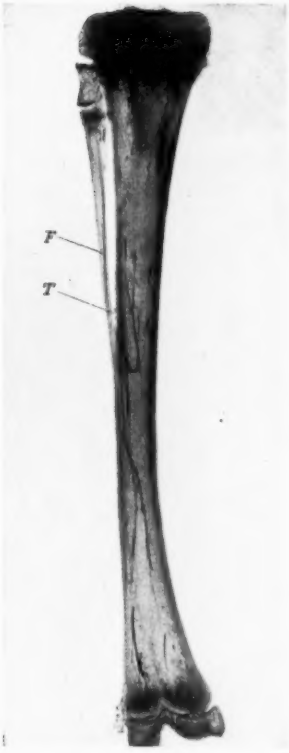

Fig. 13.

Fig. 14.

Fig. 15.

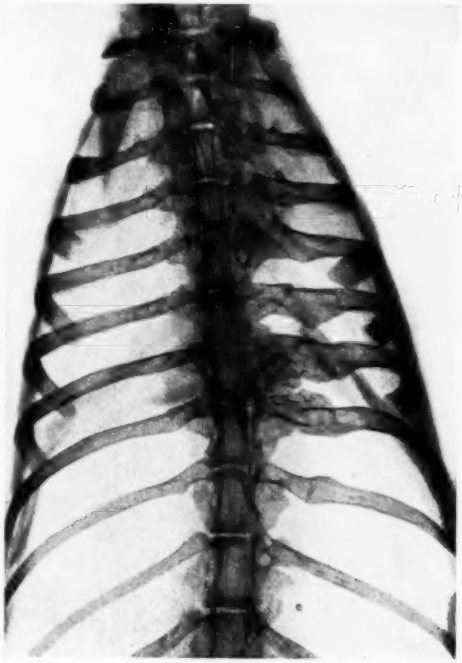

Fig. 16.

Fig. 17.

Fig. 18.

L. Fig. 19.

R. Fig. 20.

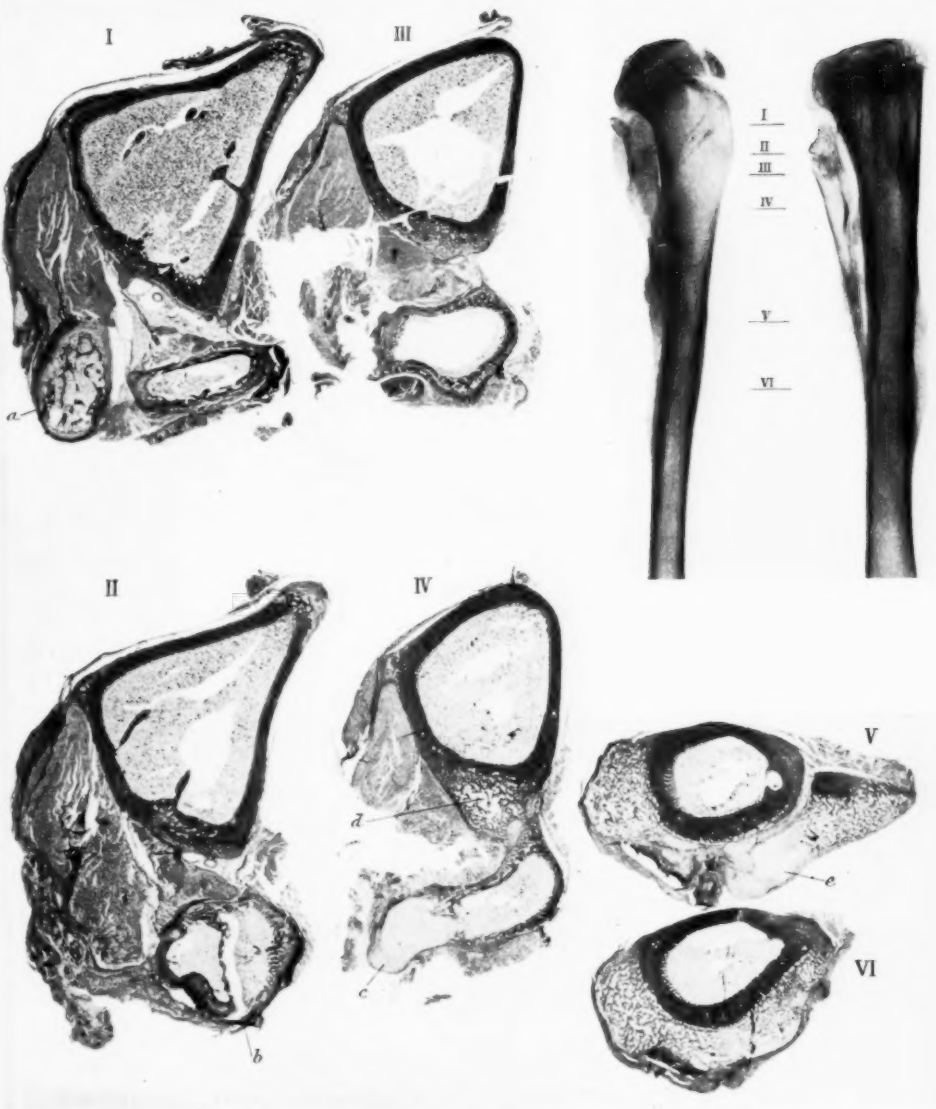

Fig. 21.

AUS DER KLINIK DES ANTONI VAN LEEUWENHOEKHUIS, AMSTERDAM
(NIEDERLÄNDISCHES INSTITUT FÜR KREBSFORSCHUNG)

RÖNTGENBESTRAHLUNG NACH RADIKALOPERATION DES BRUSTDRÜSENKREBSES

von

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Bis zum heutigen Tag ist man nicht darüber einig, was man von der Röntgenbestrahlung nach der sogenannten Radikal-Operation bei Brustdrüsenkrebs erwarten darf. Die Mitteilungen widersprechen einander noch immer. Es ist schwer zu ergründen, inwiefern die Unterschiede in der Bestrahlungstechnik hierauf von Einfluss sind, und ob auch Unterschiede in der Zusammenstellung des Patientenmaterials dazu mitgewirkt haben, die Erfolge so ungleich zu gestalten.

Vorläufig bleibt es möglich anzunehmen, dass eine gleiche Bestrahlungsmethode für den einen Fall von Nutzen, für den anderen nachteilig gewesen ist, und dass mit einer anderen Methode der Erfolg vielleicht umgekehrt gewesen wäre.

Durch ausschliessliches Literaturstudium — ich verweise hierfür auf die Auseinandersetzung der beiden Berichterstatter FORGUE und WALTHER auf dem Kongress der französischen Gesellschaft für Heilkunde 1922 — gelingt es nicht einmal zu einer Arbeitshypothese zu gelangen, möge es daraus auch wahrscheinlich werden, dass die moderne massive Röntgenbestrahlung für den Brustdrüsenkrebs im Durchschnitt mehr Übles als Gutes bringt.

Versucht man andrerseits durch ein mehr detailliertes Studium jedes Einzelfalles (den Weg der Statistik also verlassend) sich ein Urteil zu bilden, dann gelingt dies nicht, weil gewöhnlich weder über den Zustand vor der Operation, noch über die Befunde bei der Autopsia in vivo, noch über die Ergebnisse der path.anat.-Untersuchung, noch über den weiteren Verlauf genügend vollständige und genaue Kenntnis zu erlangen ist. Und diese Kenntnis ist es, welche gerade beim Brustdrüsenkrebs, mit seiner grossen Verschiedenheit im Vorkommen und im Verlauf so durchaus unentbehrlich ist.

Bei unseren Untersuchungen haben wir denn auch keine in den Krankengeschichten vorhandenen Angaben unbeachtet lassen können. Operationsberichte, path.anat.-Beschreibungen entfernter Gewebe haben wir heranziehen, viele mikroskopische Präparate wieder hervorsuchen, sowie durchmustern müssen.

Da ich nun glaube durch diese Nachforschungen wenigstens einen kleinen Schritt vorwärts gekommen zu sein, meine ich, dass es seinen Nutzen hat, unsere Resultate zu publizieren.

Hiernächst werden wir also so kurz wie möglich unser Material besprechen, und uns dann die Frage stellen, ob die angewandte Nachbestrahlung im allgemeinen genützt hat oder nicht, zweitens ob sie vielleicht Einigen von Nutzen, Anderen schädlich gewesen ist.

ÜBERSICHT DES EIGENEN MATERIALS

In der Klinik des Antoni van Leeuwenhoekhuis zu Amsterdam sind in der Zeit von 1915 bis Anfang 1921,[1] 200 an Brustdrüsenkrebs leidende Patienten behandelt worden. Wir können nach dem Behandlungszustand, in dem diese Frauen zu uns kamen, die folgende Einteilung machen.

Gruppe 1. Hierzu rechnen wir die Patienten, die auch anderswo noch nicht behandelt waren; wir werden sie die primären Fälle nennen. Diese Gruppe zählt 78 Patienten.

Gruppe 2. Diese umfasst 30 Leidende, bei denen anderswo eine Amputatio mammae vorgenommen war, und die uns zur prophylaktischen Nachbestrahlung zugeschickt wurden, also höchstens einige Wochen nach der Operation. Einige unter diesen hatten damals schon an anderen Stellen Metastasen. Bei vielen wurde vom Chirurgen in Anbetracht der Ausdehnung der Geschwulstbildung befürchtet, dass nicht alles Geschwulstgewebe entfernt worden war. Alle diese haben für unsere Nachforschung weniger Wert, als die eigenen Fälle, da leider oft keine pathologisch-anatomische Untersuchung vorgenommen war, und auch weil über die Ausdehnung, die bei der klinischen Untersuchung ermittelt werden konnte, später nichts mehr zu erfahren ist. Gleichwohl sind sie uns willkommen als Vergrösserung unseres Studiummaterials.

Gruppe 3. Hierzu gehören diejenigen, bei denen früher die Brust amputiert worden war, und welche entweder auf den Rat des Operateurs oder spontan mit einem Rezidiv zu uns kamen. Diese Gruppe

[1] Ich will hier bemerken, dass absichtlich nur die Fälle bis 1921 bearbeitet sind, da diese alle auf die gleiche Weise behandelt worden sind. Seitdem hat sich unsere Technik geändert.

ist die grösste und zählt 92 Fälle. Für uns ist sie am wenigsten von Wert. Ihr grösster Nutzen bestand darin, dass sie als Vergleichsmaterial dienen konnte.

Besprechung der Gruppen

Gruppe 1

Bei 48 Patienten war, bevor dieselben Hilfe suchten, die Existenz der Geschwulst verschieden lang bekannt. Die folgende Tabelle gibt hierzu eine Übersicht.

Kürzer als 1 Monat	11
1 bis 3 Monate	7
3 bis 6 Monate	16
6 bis 12 Monate	20
1 bis 2 Jahre	14
2 bis 3 Jahre	4
3 bis 4 Jahre	2
4 bis 5 Jahre	2
Länger als 5 Jahre	2

Auch betreffs des Alters der Patienten und der Ausdehnung des Prozesses sowie in bezug auf den histologischen Typus bestand grosse Ungleichheit. Fernerhin waren diese Faktoren, welche den Ablauf der Krankheit, auch wenn eine Behandlung hierauf nicht von Einfluss ist, in bedeutender Weise mitbestimmen, auf alle mögliche Art kombiniert. Es war also gänzlich unmöglich Untergruppen von genau vergleichbaren Fällen herzustellen.

Wir haben das Material dieser Gruppe zunächst nach der dabei angewandten Behandlungsmethode und nachher nach der Ausdehnung des Prozesses aufgeteilt. Nach der Behandlung verteilt bekamen wir drei Untergruppen.

a. 57 Patienten, bei denen eine Operation mit Ausräumung der Achselhöhle vorgenommen wurde, gefolgt von prophylaktischer Röntgenbestrahlung. (Technik wird noch näher erörtert.)

b. 18 Patienten, bei denen ausschliesslich Bestrahlung angewandt wurde. Bei ihnen war der Prozess zu weit fortgeschritten, um von einer Operation auch nur den geringsten Erfolg erwarten zu dürfen.

c. 3 Patienten, bei denen nur die Brustgeschwulst entfernt, und nachher Brust und regionäres Gebiet bestrahlt wurde. Bei 2 dieser Fälle wurde die grosse geschwürig zerfallende Geschwulst nur vom palliativen Standpunkt entfernt. Beide Patienten sind bald gestorben. Der dritte Fall betraf eine 84jährige Frau mit kleinem Tumor mammae, ohne fühlbare Achseldrüsen. Hier wurde in Be-

rücksichtigung ihres hohen Alters nur die kleine Geschwulst aus der Brust entfernt. Bis heute blieb sie rezidivfrei.

Gruppe Ia. ist für den Zweck unserer Untersuchung die wichtigste. Wir werden diese also ausführlich besprechen.

Nach der Ausdehnung des Prozesses bekamen wir folgende Einteilung:

Tabelle I. Gruppe Ia

	Total.	Am Leben.
Ohne Metastase in der Achselhöhle[1]	10	4
Mit » » » »	24	8
Mit Hautinfiltration und Metastase in der Achselhöhle	11	1
» » » » » » » und supraclaviculär	7	0
Ohne » , mit Metastase in Achselhöhle und supraclaviculär	5	0

Wie schon aus dieser Tabelle hervorgeht, war das Carcinom bei vielen dieser Patienten inoperabel, wenn man darunter versteht, dass bei der Operation, sowie diese ausgeführt wurde, sicherlich Geschwulstgewebe zurückblieb. In den meisten dieser Fälle erwartet man denn auch gewöhnlich von einer blossen Operation keinen Erfolg.

Bei all diesen Patienten wurde zuerst eine Amputatio mammae mit Ausräumung der Achselhöhle vorgenommen. Hierbei wurde der M. pect. major ohne Ausnahme mitentfernt, der M. pect. minor nur dann, wenn sich unter diesem offenbar Geschwulstgewebe enthaltende Drüsen fortsetzten. Resektion oder Durchsägung des Schlüsselbeins zur weiteren Verfolgung möglicher Metastasen wurde niemals angewandt. Von der Haut wurde nur der unmittelbar über und in der Nähe der Geschwulst gelegene Teil geopfert, oder soviel mehr, als von einer sichtbaren intrakutanen Ausdehnung angegriffen war. Fast immer liess sich denn auch die Hautwunde primär schliessen. Eine Woche bis 14 Tage nach der Operation wurde mit der Röntgenbestrahlung angefangen. Diese wurde wie folgt ausgeführt:

Das Operationsgebiet wurde in vier aneinander schliessende viereckige Felder von 10×10 cm. eingeteilt, die nach oben hin bis an das Schlüsselbein reichten; die Wundlinie bildete ungefähr die Diagonale des Gebietes. Ausserdem wurde die Achselhöhle bestrahlt, mit einem runden Feld von 8 cm. Durchmesser, dasselbe geschah auch meist in den supraclaviculären Gruben. Als Filter wurde bis Mitte 1917 5 mm. Aluminium plus Leder gebraucht, nachher ein $^1/_2$ mm. Zink plus Leder. Bis zum Jahre 1918 wurde bei einer Spannung von 150,000 Volt gearbeitet, später bei 170,000 Volt. Die Focushaut-

[1] Durch mikroskopische Untersuchung festgestellt. Oft entsprach deren Ergebnis nicht dem klinischen Eindruck vor der Operation. Fühlbare Drüsen enthalten oftmals keine, nicht fühlbare, eben so oft doch Geschwulstzellen. Dass keine Achselmetastasen vorhanden waren, schloss jedoch in zwei Fällen nicht aus, dass trotzdem infraclaviculäre Metastasen bestanden.

distanz betrug 20—24 cm. Die Dosis wurde in Holzknecht-Einheiten gemessen. Pro Feld wurden in einer Serie zuerst 20 H., später 30 H. verabreicht. Die ganze Behandlung bestand aus 2 oder 3 derartigen Serien. Die Patienten wurden wenn möglich jeden Tag bestrahlt. An einem Tage wurde meistens ein Feld bestrahlt und mit 10 H. beschickt.

Zwischen der ersten und zweiten Serie wurde eine Pause von 4 Wochen eingeschaltet, zwischen der zweiten und dritten Serie eine von 8 Wochen.

Die Bestrahlung bezweckte also nur, Rezidive im Operationsgebiet und in den regionären Drüsen der Achsel- und supraclaviculären Grube zu verhüten und nicht, wie in der letzten Zeit versucht wird, auch mehr entfernte Gebiete, z. B. das Mediastinum oder die ganze Brustkorbhälfte an der kranken Seite vor Tumorwachstum zu bewahren.

Wir werden nun erst auf die übliche Weise zusammenstellen, wie es diesen 57 Patienten ergangen ist. Nach einer Beobachtungszeit von 2 bis 7 Jahren sind noch 13 von ihnen am Leben. Tabelle I zeigt, welche Ausbreitung die Geschwulst bei Antritt der Behandlung hatte. Die übrigen 44 sind nach kürzerer oder längerer Zeit einem Rezidiv oder einer Metastase erlegen, 27 unter diesen schon innerhalb eines Jahres nach dem Anfang unserer Behandlung.

Von unseren 57 Patienten kamen 28 vor mehr als 5 Jahren in Behandlung; von diesen sind augenblicklich 5 am Leben; vor mehr als 3 Jahren 47, von denen noch 11 am Leben sind.

Es schien uns nun eine wichtige Frage, an welcher Stelle das Rezidiv oder die Metastase auftritt und ob wir hierin einen Zusammenhang mit der angewandten Behandlung sehen konnten. Es zeigte sich folgendes:

Tabelle II[1]

Gestorbene von Gruppe I	Total	Hiervon innerhalb eines Jahres.
Rezidiv in dem behandelten Gebiet	13	11
Supraclaviculär	4	3
Metastase in entfernten Gebieten	19	11
Andere Mamma	3	2
Stelle unbekannt	4	0
Wahrscheinlich nicht an Carcinom gestorben	1	0
	44	**27**

[1] Als Rezidiv rechneten wir Geschwülste, die vor der Operation bei klinischer Untersuchung nicht angetroffen wurden; vor der Behandlung bereits fühlbare, vergrösserte und indurierte supraclaviculäre Drüsen, welche gleich blieben, nach anfänglicher Verkleinerung wieder zunahmen, oder ihr Wachstum ohne Verzögerung fortsetzten, wurden nicht als Rezidiv betrachtet.

In den 13 Fällen, wo ein Rezidiv in dem bestrahlten Operations-Gebiet auftrat, war dieses 12 mal in der Haut; dies ereignete sich nur in denjenigen Fällen, in denen vor der Operation bereits eine Hautcarcinose bestanden hatte, nur ein einziges Mal war vorher in der Haut kein Carcinom entdeckt worden. Einmal zeigte sich ein Rezidiv in einer operierten Achselhöhle.

Die 4 supraclaviculären Rezidiven entstanden bei den folgenden Fällen: 3 mal bei sehr stark infiltrierter Achselhöhle, einmal war die infraclaviculäre Grube bereits in Mitleidenschaft gezogen.

Von den 19 Fällen mit Metastasen in entfernten Gebieten, betraf nur einer eine Patientin ohne Metastase in den Achseldrüsen und drei Fälle, bei denen die Achselhöhle leicht angegriffen war. In diesen 4 Fällen kamen die inneren Metastasen denn auch erst nach Jahren zur Äusserung. Die 11 Sterbefälle innerhalb des Jahres betrafen ausschliesslich Frauen, bei denen das Tumorwachstum vor der Operation schon sehr weit fortgeschritten war (zum grössten Teil in die Haut und supraclaviculär). Die andere Brustdrüse wurde einmal angegriffen als Folge einer neuen Manifestation der Krebskrankheit, nicht als Metastase der zuerst angegriffenen Brustdrüse. Es lag also ein Carcinoma duplex vor. In den 2 anderen Fällen war die Achselhöhle angegriffen gewesen. Diese beiden letzten starben innerhalb eines Jahres. Bevor wir nun auf eine nähere Betrachtung eingehen, werden wir erst auch die anderen Gruppen behandeln.

Gruppe II

Wie schon mitgeteilt, ist von fast Allen nicht oder ungenügend bekannt, in welchem Zustande sie sich vor der anderswo vorgenommenen Operation befanden. In der Anamnese fanden wir, dass die Dauer des Prozesses vor dieser ersten Behandlung die folgende war:

Kürzer als 1 Monat	3
1 bis 3 Monate	4
3 bis 6 Monate	9
6 bis 12 Monate	8
1 bis 2 Jahre	1
4 Jahre	1
	30

Zehn von diesen hatten, als sie bei uns in Behandlung kamen, schon vergrösserte supraclaviculäre Drüsen, oftmals kombiniert mit Achseldrüsenschwellung. Von einer Patientin war bekannt, dass vor der Operation eine grosse Hautinfiltration bestand. Von diesen 30 Patienten sind nach 2 bis 7 Jahren noch 5 am Leben; keine von

diesen 5 hatte beim Anfang unserer Behandlung supraclaviculäre oder Achseldrüsenschwellungen.

Die Bestrahlung wurde in der gleichen Weise ausgeführt, wie es für die Fälle der Gruppe I. beschrieben ist.

Was die Stelle des Rezidivs betrifft, fanden wir folgendes:

Tabelle III

Gestorbene aus Gruppe II.	Total	Hiervon innerhalb des ersten Jahres
Rezidiv im behandelten Gebiet	7	7
Supraclaviculär	6	5
Metastase in entferntem Gebiet	7	5
Andere Mamma	1	1
Stelle unbekannt	4	2
	25	20

Gruppe III

Diese Gruppe umfasst die 92 Fälle, die uns mit einem Rezidiv nach früher anderswo ausgeführter Amputatio mammae zur Behandlung zugeschickt wurden. Diese gehören also nicht direkt zum Gegenstand unseres Studiums.

In 21 Fällen war das Rezidiv nur auf ein Gebiet beschränkt (es waren darin dann oftmals ein oder mehrere Knoten). In all den übrigen Fällen kamen verschiedene Kombinationen vor. In den 21 Fällen, wo nur in einem Gebiet Rezidiv angetroffen wurde, war die Stelle wie folgt:

Intracutan	2
Subcutan	5
Achselhöhle	2
Supraclavicular-Grube	6
Auf Rippe, Brust- oder Schlüsselbein	6
	21

Bei sämtlichen 92 Fällen wurde angetroffen:

55 mal Rezidiv in Cutis oder Subcutis.
25 » » » der Achselhöhle der operierten Seite.
27 » » » der anderen Achselhöhle.
47 » » supraclaviculär.
24 » » auf Rippe, Brust- oder Schlüsselbein.
4 » » in der Pleura.

Die Behandlung bestand bei einigen von diesen Fällen in Ausschneidung des Rezidivs mit nachfolgender Bestrahlung. In weitaus den meisten Fällen wurde jedoch ausschliesslich Röntgenbestrahlung angewandt.

Von diesen 92 Patienten sind augenblicklich, nach 2 bis 4 Jahren, noch 8 am Leben, von welchen 2 ausser der Bestrahlung auch operiert worden. Ausgenommen eine Patientin, bei welcher nebst einem Tumorpaket in beiden Achselhöhlen auch eine supraclaviculäre harte Drüsenschwellung vorhanden war, hatten die übrigen sich noch am Leben befindenden Patienten, ein nur auf ein Gebiet beschränktes Rezidiv.

Alles zusammenfassend waren die Resultate in den drei Gruppen wie folgt:

Tabelle IV

	Total.	Rezidiv-frei am Leben.	Vor mehr als 5 Jahren in Behandlung gekommen.	Am Leben.	Vor mehr als 3 Jahren in Behandlung gekommen.	Am Leben.
Gruppe I	78	15	38	5	57	11
Gruppe Ia	57	13	28	5	47	11
Gruppe II	30	5	12	2	21	3
Gruppe III	92	8	45	2	71	4

BETRACHTUNGEN

Was wir nun wissen möchten, ist folgendes:

Unterscheiden sich unsere Resultate von denen, die man früher erzielte, günstig oder ungünstig?

a. Im Heilungsresultate.

b. Im Verlauf.

Wir brauchen kaum darauf hinzuweisen, dass dies auf statistischem Wege hier nicht annähernd zu berechnen ist. Wir fanden jedoch einen anderen Weg.

Nach genauem Studium unserer Fälle der Gruppe I und II und Vergleich dieser mit Gruppe III war es uns möglich *einen Unterschied in der Lokalisation der Rezidive* festzustellen. Hierzu ist eine Voraussetzung nötig: man muss wissen, dass zwischen intra- und subcutanen Rezidiven[1] ein Unterschied zu machen ist. Unter den ersten

[1] Auf die Entstehungsweise beider Arten von Rezidiven werden wir hier nicht eingehen. Die subcutanen sind zum Teil wahrscheinlich Impfrezidive, welche bei der Operation gemacht worden sind.

verstehen wir die so typische lenticuläre Hautcarcinose und auch die Lymphangitis carcinomatosa cutis mit ihrer, in fortgeschrittenen Stadien, so charakteristischen flammigen Röte.

Zu den zweiten rechnen wir die gewöhnlich in der Nähe der Narbe gelegenen, subcutan entstandenen, oftmals solitären Knoten, welche später mit der Haut verwachsen können.

Während nun in den von uns nachbestrahlten Fällen sowohl von Gruppe I, wie von Gruppe II, in keinem einzigen Fall solch ein Rezidiv im Unterhautzellgewebe gefunden wurde, waren diese sehr zahlreich bei den Patienten, die wir von anderswo mit einem Rezidiv zugesandt bekamen und die also nicht nachbestrahlt waren.[1]

Es besteht jedoch noch ein anderer Unterschied. Auch die wohlbekannten, mit Rippen, Brustbein und Schlüsselbein verbundenen Knoten, die bis zu einer beträchtlichen Grösse auswachsen können und sich gewöhnlich nur solitär oder in beschränkter Anzahl vorfinden, treffen wir bei unserem Material nicht an. Andrerseits sieht man, wie diese bei den nicht bestrahlten Patienten zu einem sehr gewöhnlichen Rezidivtypus gehören. Etwas ähnliches fanden wir bei der Achselhöhlenmetastase.

Zwei Fällen von Achselhöhlenrezidiv auf der operierten Seite in unserem Material, stehen 25 derartige Rezidive an dieser Stelle bei den nicht bestrahlten Patienten, gegenüber. Dabei ist zu beachten, dass dieses Ausbleiben eines Rezidivs in unseren Fällen um so merkwürdiger ist, als bei mehreren die Achseldrüsen tatsächlich ausgegraben werden mussten. Die meisten erlagen später nur inneren Metastasen.

Sind wir nun berechtigt diesen bedeutenden Unterschied wirklich der anderen Behandlungsweise zuzuschreiben? Natürlich dürfen wir nicht ausser Acht lassen, dass die Fälle, welche uns als Rezidiv zugesandt werden, ein Auswahlmaterial darstellen; denn sowohl die gutverlaufenden wie die rasch zum Tode führenden sind nicht darunter.

Von unseren eigenen Patienten dagegen — mögen diese sich durchschnittlich zweifellos in einem schlechteren Zustande befinden als diejenigen, die in anderen Kliniken zur Operation kommen — ist zu erwarten, dass unter ihnen mehr gleichmässig alle verschiedenen Typen vertreten sind.

Auch kann es von Bedeutung gewesen sein, welche Operationsmethode gewählt war und wie dieselbe angewandt worden ist. Unserer Meinung nach ist dies jedoch nicht imstande obengenannten Unterschied zu erklären. *Wir müssen also ganz entschieden dieses*

[1] Es mag sein, dass hierbei auch eine weniger gute Operationstechnik im Spiele gewesen ist. Von grosser Bedeutung kann das nicht gewesen sein, da wir die meisten der betreffenden Chirurgen als sehr gewissenhaft kennen.

Ausbleiben der subcutanen Rezidive, sowie der mit Rippen, Brust- und Schlüsselbein verwachsenen Knoten, wie auch der Achselmetastase als einen günstigen Erfolg der prophylaktischen Nachbestrahlung betrachten. Schliesslich müssen wir noch darauf aufmerksam machen, dass wir bei den wirklichen *intra*cutanen Rezidiven keinen solchen Unterschied sahen. Diese kommen bei den nachbestrahlten Patienten wie bei den nicht nachbestrahlten vor, und wir bekamen nicht den Eindruck, dass es je gelungen ist durch die prophylaktische Bestrahlung solch einem Rezidiv vorzubeugen. Auf letzteres kommen wir noch weiter zurück.

Stehen diesen Vorteilen der prophylaktischen Röntgenbestrahlung auch Nachteile gegenüber?

Der einzige Weg diese Frage zu beantworten ist nachzusehen, ob bei allen Fällen, die ungünstig verlaufen sind, vermutet werden konnte, dass die Röntgenbestrahlung daran Schuld hat, d. w. s. ob man bei einem bestimmten Fall, wenn keine Bestrahlung angewandt worden wäre, einen anderen Ablauf hätte erwarten können. Um dies zu ergründen, werden wir der bereits früher gemachten Einteilung folgen, die das Stadium der Geschwulstausbreitung, womit die Patienten vor der Behandlung zu uns kamen, angibt.

a. *Ohne Metastasen in der Achselhöhle.* Von diesen 10 Patienten sind 6 gestorben. Wie war hier der Verlauf?

Eine Frau von 75 Jahren ist so gut wie sicher nicht ihrem Krebs erlegen, und hat bis zu ihrem Tode nichts gezeigt, was auf ein Rezidiv weisen könnte. Bei einer anderen von diesen 6 Patienten entstand ein intracutaner Auswuchs, welcher ausschliesslich auf den medial von der Narbe gelegenen Hautlappen beschränkt blieb und seitwärts von der Narbe begrenzt wurde. Nach der eigenartigen Anordnung der Hautknötchen und nach der scharfen Lokalisation meinen wir hier annehmen zu müssen, dass hier bereits vor der Operation eine für das blosse Auge unsichtbare Infiltration der Hautlymphgefässe bestanden haben muss und ein Teil der infizierten Haut nicht mit entfernt worden ist. Es wäre denkbar, dass die Bestrahlung das Hautcarcinom in diesem Falle gefördert hat.

Bei zwei anderen Frauen bestand eine grosse Geschwulst vom oberen und medialen Quadranten der Brustdrüse. Wie bekannt, metastasieren diese nicht oder nur selten nach der Achselhöhle hin, sondern direkt nach dem Mediastinum und den infraclaviculären Drüsen. Bei der Einen waren denn auch bereits vor der Operation überfüllte Venen auf der Brustwand vorhanden, welche fraglos auf eine Verhinderung des Abflusses hinwiesen. Die andere hatte ausgedehnte Drüsenmetastasen in der Mohrenheimschen Grube. Aus dem Operationsbericht geht ausserdem hervor, dass so gut wie sicher nicht mehr alle Drüsenmetastasen erreicht werden konnten. Trotz

des Fehlens der Achseldrüsenmetastasen hatten diese beiden Fälle also eine sehr ungünstige Prognose. Beide Patienten bekamen denn auch eine Metastasierung im Mediastinum.

Im fünften Fall entstand nach $2^1/_2$ Jahren eine weit ausser dem bestrahlten Gebiet gelegene Metastase, der sie nach gut 3 Jahren erlag.

Bei der sechsten Patientin entwickelte sich nach 3 Jahren eine Geschwulst in der anderen Brustdrüse, mit weit ausgedehnter Achseldrüsenmetastase. Der histologische Typus war hier ganz verschieden von dem der primären Geschwulst aus der anderen Brust, und auch der Wachstumstypus war ein anderer. Auch vom patholog. Anatomen wurde hier ein Carcinoma duplex angenommen.

Man sieht also, dass in keinem dieser 6 Fälle ein nachteiliger Einfluss der Bestrahlung nachzuweisen ist.[1]

b. *Mit Metastasen in der Achselhöhle.* Von diesen 24 Fällen hatten 6 eine ulcerierende Brustgeschwulst, 3 von diesen gehörten zu den 8 sich noch am Leben befindenden Patienten. Bei diesen 8 noch Lebenden waren die Achseldrüsen, wie die mikroskopische Untersuchung später zeigte, nur leicht angegriffen. Die an den Rändern des Achselfetts gelegenen Drüsen zeigten sich n. l. frei von Geschwulstzellen. Die günstige Prognose, welche man hierauf stellen konnte, hat sich also als richtig bewährt.

Von den 16 Patientinnen, welche den Metastasen erlagen, gehörten 3 ebenfalls zu diesem Typus, so dass auch bei diesen ein günstiger Verlauf erwartet wurde. Zwei von ihnen starben trotzdem an Brustfellinfiltration; eine nach 3 Jahren und einem Monat, die andere nach 2 Jahren und 4 Monaten. Schon die lange Zeit zwischen der Bestrahlung und dem Auftreten dieser Metastasen machte es sehr unwahrscheinlich, dass hier ein Zusammenhang zwischen beiden gedacht werden muss. Die dritte Patientin starb nach einem Jahre und 3 Monaten an einer Gehirnmetastase. Da der Kopf ganz gewiss nicht von der Bestrahlung mitbetroffen wurde, ist es schwer anzunehmen, dass diese hieran Schuld war.

Nun wollen wir nachsehen, woran die 13 übrigen Frauen gestorben sind, bei denen die Achselmetastasen oft sehr ausgedehnt waren und bei denen man also auch ohne Bestrahlung wenig Hoffnung auf eine bleibende Genesung hätte hegen können. Zwei von ihnen bekamen ein Rezidiv in der Haut; bei der einen war dieses grade da gelegen, wo die Öffnung zur Drainage gemacht worden war. Diese lag ausser dem bestrahlten Gebiet, so dass sich hier die prophylaktische Wirkung der Bestrahlung nicht hatte entfalten können.

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[1] Jedenfalls nicht als Folge ihrer örtlichen Wirkung.

Bei der zweiten entstand später eine Lymphangitis carcinomatosa, welche zuerst ausser dem bestrahlten Gebiet auftrat, und erst später darin fortschritt. Die Patientin hatte vor der Operation die Geschwulst massiert, sodass eine besondere Ursache dafür vorhanden war, dass die Lymphbahnen, bis auf weite Entfernung von der Geschwulst mit Krebszellen überschwemmt waren, ohne dass diese mikroskopisch sichtbar war.

Die übrigen elf starben mit Erscheinungen von:

1 Gehirnmetastase.
2 Wirbelsäulemetastasen.
1 Pleurametastase.
1 Pleura- und Lebermetastase.
1 Lebermetastase.
3 Lungenmetastasen.
1 Metastase in der anderen Brustdrüse und allgemeine Carcinose.
1 Unbekannter Ursache.

Nur die 3 Fälle von Lungenmetastase und den von Brustfellmetastase werden wir, weil sie innerhalb des bestrahlten Gebietes fallen, etwas näher betrachten.

Die 3 Lungengeschwülste traten bei Fällen auf, wo bei der Operation weit unter dem M. pectoralis minor sich fortsetzende Drüsenmetastasen angetroffen wurden. Diese liessen sich nur mit der grössten Mühe entfernen. Die später gemachte Röntgenaufnahme zeigte denn auch, dass die intrathoracale Geschwulst in einem von diesen Fällen sich in dem unmittelbar daran grenzenden Gebiet entwickelt hatte. In dem einen Fall von Pleurametastase verfügen wir ausnahmsweise nicht über genügend Angaben, so dass hier keine besondere Erklärung zu geben ist.

c. *Fälle, wo bereits vor der Operation eine wirkliche Hautinfiltration bestand.*

Von all diesen Patientinnen ist nur eine am Leben. Da sie eine wenig verbreitete Hautcarcinose hatte, war es möglich gewesen, diese bis weit ins gesunde Gewebe zu entfernen. Da es bei keiner der Übrigen der Nachbestrahlung gelungen ist die Hautcarcinose auf die Dauer zu bezwingen, muss man hieraus erschliessen, dass die Röntt-

[1] Den Fall mit Drüsenschwellungen in beiden Achseln und supraclaviculär, den wir als Rezidiv in Behandlung bekamen.

[2] Auch in Fällen, wo die Achseldrüsen sozusagen ausgegraben werden, zeigten sich später in diesem Gebiet nie Rezidive. Die meisten starben später an inneren Metastasen. Einem merkwürdigen Fall begegneten wir kürzlich. Bei einer anderswo operierten, bei uns vor einigen Jahren nachbestrahlten Patientin, entwickelte sich ein Rezidiv, gerade in dem unbestrahlt gebliebenen, ungefähr 2 cm breiten Streifen, zwischen zwei Hautfeldern, die durch ihre Pigmentation noch genau zu erkennen waren.

genbestrahlung in diesen Fällen ohnmächtig ist. Beim einzigen geheilten Fall ist das Ausbleiben von Rezidiven also der chirurgischen Behandlung zu danken. Im Gegensatz hierzu bekamen wir bei einigen Fällen den Eindruck, dass die schon bestehende Hautcarcinose durch die Bestrahlung verschlimmert wurde. Fast alle starben innerhalb eines Jahres.

d. *Fälle ohne Hautinfiltration, jedoch mit Metastasen in der Achsel und supraclaviculär.*

In diesen Fällen hatte die Röntgenbestrahlung niemals einen bleibend guten Erfolg, wiewohl der palliative Wert in den inoperabeln Fällen bedeutend genannt werden muss und das Leben in einigen Fällen mit einigen Jahren verlängert wurde.

ZUSAMMENFASSUNG

Wir können also erklären, dass der Verlauf in all unseren Fällen wenig von der, auf Grund der gefundenen Ausbreitung, bereits bei der Operation zu stellenden Prognose abgewichen ist. Wir begegneten nur einem Fall, in dem eine ungünstige Erwartung sich nicht bestätigt hat. Andrerseits sahen wir auch keine anfangs günstig erscheinenden Fälle, deren schlechter Verlauf der Röntgenbestrahlung zugeschrieben werden kann. Wir müssen jedoch darauf hinweisen, dass es durch Anwendung prophylaktischer Nachbestrahlung möglich ist, *mit Sicherheit die subcutanen Rezidive und die auf Rippen und Brustbein zu verhüten*, während es gerade diese waren, die bei einer ausschliesslich operativen Behandlung eine sehr unsichere Gruppe bilden. Nicht selten waren es diese unberechenbaren solitären lokalen Rezidive, die früher, entweder selbst zum Tod führten oder den Ausgangspunkt zu einer weiteren Verbreitung des Krebses darstellten. Auch kann man Rezidiven in der Achselhöhle so gut wie sicher vorbeugen, sogar wenn dieselbe stark angegriffen war. Die so äusserst quälenden, im Plexus brachialis wachsenden Rezidive kamen bei den Patienten, die von uns nachbestrahlt wurden, denn auch nicht vor.

Müssen wir nun in Zukunft vorbeugende Röntgenbestrahlung bei Brustdrüsenmetastase anwenden oder nicht?

Man muss voraussetzen, dass diese Frage nicht im allgemeinen beantwortet werden kann. Sowie bereits früher erwähnt worden ist, müssen wir die Fälle mit und die ohne Hautinfiltration unterscheiden. Für die letzte Gruppe wagen wir es, infolge unserer Erfahrung, die Nachbestrahlung zu empfehlen. Jedoch unter dem Vorbehalt, dass diese nach der von uns beschriebenen Technik geschieht, d. i. mit mässig harter Röntgenbestrahlung, mässiger und in gewissem Sinne fraktionierter Dosis. Dagegen scheint es uns sehr gut möglich, dass

die moderne, viel massivere und mehr durchdringende, und deshalb auch so viel schädlichere Bestrahlung ganz andere Resultate geben, und vielleicht mehr schaden als nützen würde. *Beabsichtigt man also nur die Sterilisierung des Operationsfeldes, dann halten wir vorläufig nur diese mehr gemässigte Bestrahlungsweise für gestattet.* Bei der Operation prinzipiell viel Haut zu entfernen, wie es von Einigen geschieht, auch bei Fällen ohne sichtbare Hautinfiltration und wo die Geschwulst nicht mit der Haut verwachsen ist, hat unsrer Meinung nach, bei Anwendung von Nachbestrahlung keinen Sinn.[1]

Es kommt uns jedoch nicht unwahrscheinlich vor, dass durch Benützung härterer Strahlen in grosser Dosis bei den Fällen mit intracutaner Infiltration vielleicht mehr zu erreichen wäre als mit der alten Technik. Einige inoperable Fälle dieses Typus, welche in der letzten Zeit mit vorläufig günstigem Erfolg in dieser Weise behandelt worden sind, lassen uns dies erwarten. Ob dieser günstige Erfolg jedoch stetigen Wert haben wird und diesem keine Gefahren gegenüberstehen, muss die Zukunft lehren. Vorläufig müssen wir bei den Fällen mit intracutaner Infiltration, wenn diese nicht allzu sehr verbreitet ist, nur auf die Operation vertrauen. Hierbei muss soviel Haut geopfert werden, wie die Sicherheit es gebietet, ohne darauf zu achten, ob man die Wunde primär schliessen kann oder nicht. Wohl halten wir es für berechtigt bei denjenigen Fällen, bei denen man doch bald ein intracutanes Rezidiv erwarten kann, wie sich aus der mikroskopischen Untersuchung der entfernten Gewebe ergibt, versuchsweise mit der modernen Röntgenbestrahlung nachzubehandeln.[2]

Schliesslich haben wir noch die Fälle, bei denen man entweder schon bei der Operation oder aus Gründen einer genauen pathologisch-anatomischen Untersuchung erwarten kann, dass weitere Verbreitung der Krebszellen, ausser den für das Messer erreichbaren Lymphgebieten (Brusthöhle, Wirbel, u. s. w.) stattgefunden hat. Ob es in diesen Fällen nützlich ist Röntgenbestrahlung anzuwenden mit dem Zweck auch diese Keime zu erreichen und unschädlich zu machen, darauf kann unsre Untersuchung keine Antwort geben, da die Bestrahlungen nicht mit dieser Absicht stattgefunden haben. Es kommt uns jedoch nicht unwahrscheinlich vor, dass in solchen Fällen die Bestrahlungen sehr leicht schädlich sein könnten. Die grosse Zahl von Patienten dieses Typus, die bereits im ersten Jahr nach

[1] Wir wollen hier nicht urteilen über den denkbaren Nutzen sehr ausgedehnter Entfernung der Fascie und des subcutanen Fettes, wie dieses von SAMPSON HANDLEY empfohlen wird.

[2] Auch haben wir in dem letzten Jahre einige Male bei sehr verbreiteter Hautinfiltration der Operation eine Serie harter Röntgenbestrahlungen vorangehen lassen.

der Behandlung an inneren Metastasen gestorben ist, deutet vielleicht schon hierauf hin. Andrerseits muss man sehr in Zweifel ziehen, ob die Keime mit den bis jetzt angewandten Bestrahlungsmethoden, sogar wenn man sich hierum bemüht hätte, wohl hätte erreicht werden können. Wir sahen ja, dass es auch in bequem erreichbaren Gebieten bis jetzt fast nie gelungen ist, die da einmal angesiedelten Krebszellen endgültig zu vernichten oder deren Wachstum dauernd zu unterdrücken.

Aus all diesem geht hervor, dass es vorläufig noch sehr schwer ist, in diesen Fällen eine bestimmte Behandlungsweise zu empfehlen, da dieselbe sich noch in einem Stadium des Experimentes befindet.

Nur genaues Studium einer grossen Anzahl Fälle, mit allen zu Diensten stehenden Mitteln, kann uns hier weiter bringen.

ZUSAMMENFASSUNG. Die Verfasser waren in der Lage 3 Gruppen von Fällen zu vergleichen.

1. die in der Klinik des Antoni van Leeuwenhoekhuis operierten und nachbestrahlten.
2. die anderswo operierten, jedoch von ihnen nachbestrahlten.
3. die anderswo operierten, nicht nachbestrahlten Patienten, die ihnen mit einem Recidiv zugesandt wurden.

Bei den zwei ersten Gruppen, wo also eine Nachbestrahlung angewandt worden war, kamen subcutane Rezidive im Unterhautzellgewebe, in der Achselhöhle, auf Rippen, Brust-oder Schlüsselbein nicht vor. Bei den anderswo operierten und nicht nachbestrahlten waren diese dagegen sehr häufig. Sie glauben diesen absoluten Unterschied ausschliesslich der Nachbestrahlung verdanken zu müssen. Übrigens fanden sie, trotz genauer Untersuchung, keine Andeutungen, die darauf hinwiesen, dass die Bestrahlung in diesen Fällen geschadet hatte, immer wenn keine intracutane Ausdehnung bestanden hatte. In diesen letzten Fällen wurde mit Bestrahlung nie ein dauernder Erfolg erreicht.

Auf Grund ihrer Nachforschungen sind sie der Meinung, die prophylaktische Nachbestrahlung im Allgemeinen empfehlen zu dürfen, doch nur wenn diese mit einer Dosierung, wie hier angegeben wird, geschieht.

SUMMARY. The authors had the opportunity to compare 3 groups of cases.

1. Patients operated in the clinic of the Antoni van Leeuwenhoekhuis and prophylactically x-rayed.
2. Patients operated elsewhere but radiated by them.
3. Patients operated elsewhere but not treated with x-rays after operations, who were sent to them with a recurrence.

The patients of both first groups, which were treated by x-rays after operation did not get recurrences in the subcutaneous tissue, neither in the axilla, on the ribs, on the sternum or on the clavicula. On the contrary the patients of group 3 very often showed that kind of recurrence. They think this difference imputable to the x-ray aftertreatment. In spite of conscientious research they could not find any indication, the x-ray treatment had done any harm to the patients, if at least there had not been a carcinomatous

infiltration of the skin before operation. In these last cases there was never obtained any durable result by x-ray treatment.

In general x-ray after treatment seems recommandable.

RESUMÉ. Les auteurs ont pu comparer 3 groupes de cas de cancer du sein.

1. Des malades opérées dans la clinique de l'Antoni van Leeuwenhoekhuis et irradiées ensuite.

2. Des malades operées ailleurs, traitées par la radiotherapie postopératoire par eux.

3. Des malades operées ailleurs et non irradiées, qui leur furent envoyées avec une récidive.

Dans les deux premiers groupes soumis à la Rontgenthérapie postopératoire on ne rencontra pas de récidives souscutanées ni dans l'aisselle du côté malade, ni sur les côtes, le sternum ou la clavicule de la région traitée. Au contraire les malades opérées ailleurs, et non irradiées, les présentèrent très souvent. Cette différence est, selon eux, attribuable à l'action favorable de la radiothérapie postopératoire. Malgré des recherches minutieuses, rien ne fit supposer que la radiothérapie postopératoire avait été nuisible en quelque sorte, du moins s'il n'existait pas une carcinose intradermique. Dans ces derniers cas ils n'ont jamais obtenu des guérisons durables et ils ont l'impression que dans quelques cas la croissance du carcinome a été accélérée.

Ils sont de l'opinion qu'en général la radiothérapie prophylactique postopératoire peut être recommandée, à condition qu'on s'en tienne pour ce but à la dose décrite.

RESUMEN. Los autores han podido comparar 3 grupos de casos de cancer en el pecho.

1. Enfermas operadas en la clínica de Antoni van Leeuwenhoekhuis e inmediatamente irradiadas.

2. Enfermas operadas en otras partes y tratadas por la radioterapia postoperatoria en la clínica.

3. Enfermas operadas en otras partes y que no fueron irradiadas, y que fueron llevadas a la clínica con una reproducción.

En los dos primeros grupos sometidos a la acción de los rayos Rontgen después de la operación no aparecieron reproducciones subcutáneas ni en la axila del lado operada, ni en los lados, ni esternón ni en la clavícula de la región tratada. Al contrario en las enfermas operadas en otras clínicas y no irradiadas presentaron estos casos muy a menudo. Esta diferencia es, según ellos, atribuible a la acción favorable de la radioterapia post-operatoria. A pesar de estudios minuciosos, nada pudo hacer soponer que la radioterapia post-operatoria pudiese ser perjudicial en manera alguna, por lo menos si no existía un carcinoma intradérmico. En estos últimos casos, no se obtuvo jamás curaciones duraderas y tienen los autores la impresión de que en algunos casos el crecimiento del carcinoma fué acelerado.

Los autores tienen la opinión de que en general la radioterapia profiláctica post-operatoria puede ser recomendada, bajo la condición que se siga, a este objeto, la dosis indicada.

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SEPARATIONS FROM THE CAPITULUM HUMERI AS THE MOST FREQUENT DETERMINING CAUSE OF ARTHRITIS DEFORMANS CUBITI[1]

by

H. J. Panner

(Tabulæ XIII—XV)

It happens not unfrequently that a fuller recognition of the peculiarities enveloping a disease makes us realise that is is really far more common than we had formerly supposed. I believe this to be particularly true as regards the so-called "*Osteochondritis dissecans*" of capitulum humeri and its accompanying manifestations in the elbow joint. As we know, the disease owes its name to KOENIG[2] who, in 1888, first established its existence as an affection sui generis, bringing forward in support of this a number of observations, not only of its occurrence in the elbow joint, but also describing the analogous affection of the knee joint. Since that time the latter localisation has frequently attracted notice, whereas comparatively little attention has been paid to the affection in the elbow which — so far as my experience goes — is by no means recognised, neither by the surgeon nor by the roentgenologists, to an extent proportionate to the frequency of its occurrence.

What makes it all the more fitting that a roentgenologist should take this matter up is the fact that in most cases the roentgen-finding may almost be said to be pathognomonic of the affection in all its phases. This is a circumstance which has not yet been properly pointed out anywhere. By following the disease skiagraphically all through its course, a satisfactory knowledge can be gained of its entire manner of development, and in this way an excellent substitute for a series of rough pathologic-anatomical examinations is provided at the same time.

It comes natural to me to begin by describing the *distinctive roentgenographic characteristics* of the affection. It is already about 15 years since my interest for some of its roentgenological peculi-

[1] Read (in abbreviated form) at the third meeting of »Nordisk Förening för Medicinsk Radiologi».

[2] Beitr. z. klin. Chirurgie, 1888.

arities was first aroused through my examining of young male patient, in whose elbow a corpus liberum ("joint-mouse") was plainly perceptible to touch. The roentgenogram, however, showed no trace of this corpus, but only a distinct rarefaction in the capitulum humeri. What astonished me was the fact that the invisibility of the mouse was apparently inconsistent with the distinctness of the rarefaction, inasmuch as the latter would instinctively be taken as indicating the spot from which the mouse had primarily become dislodged. I therefore concluded that the corpus liberum must consist chiefly of cartilage, or at least that any bone lamina that might possibly have been separated with it, would be too thin to reveal its presence in the photographic plate; and also that the apparent defect in the capitulum humeri, as indicated by the plate, must be due, at least partly, to secondary changes at the point of separation.

Afterwards I have seen many similar cases, some of which I have been able to follow by means of roentgen-examinations from time to time. Furthermore, I have had the opportunity of examining a great number of patients presenting different places of the affection. The results of this experience, and more particularly the close observations made of about 35 cases during recent years, form the basis of this paper. However — as will be seen later on — my material is by no means limited to these cases, which fact I emphasize simply because they represent, among themselves, examples of all the peculiar, distinctive features, both roentgenologic and clinical, which I have found to be characteristic of the affection.

In the roentgen picture the first stage of the affection reveals nothing abnormal except the rarefaction already mentioned in the capitulum humeri. In some cases several of these rarefactions are observed. Their size varies from the size of a hemp seed to that of a bean; rarely larger. The degree of rarefaction may be slight or marked; as a rule it is rather sharply circumscribed and is located either in the centre of the capitulum or at its lower circumference, the usual, regular curve of which is then broken. It is relatively seldom visible in lateral pictures but stands out distinctly in the ventro-dorsal view (Fig. 1, 2, 3, 4). In many cases these rarefactions are — even for a considerable length of time — the only pathological finding obtained by the skiagraphic examination; but, besides the rarefaction, even the first examination will, as a rule, disclose a more or less pronounced intra-articular shadow corresponding to a corpus liberum. This shadow is found most frequently in the joint between the humerus and the radius — in the lateral view at the back of the radial head — or else in front of the lower part of humerus; rarely in any other locality. If the pro-

gress of the affection is followed by means of successive roentgen observations, there will often be seen the shadow of a corpus liberum, even in cases where no such body had been revealed by the previous examinations (Fig. 5, 6); or it may happen that a faint shadow already noticed on a previous occasion is found at a following examination to have become both larger and more intense. The rarefactions previously described may gradually disappear more or less completely; but very often — probably in the majority of cases — certain more or less distinct structural changes will persist, by which the origin of the affection is disclosed. Undoubtedly, however, a restitutio ad integrum *can* occur, which is so complete that no abnormity whatever is revealed by the roentgenogram. Only in such cases where the rarefaction has been located at the lower circumference of the capitulum will a flattening of the contour still be seen in this place, making it look either straighter, or slightly more curved, or perhaps a little irregularly notched (Fig. 7, 8). Instances of pronounced atrophy of the bones are very rare; the articular cavity is always well preserved.

Inasmuch as young persons are undoubtedly mostly subject to this affection, we frequently have to deal with individuals in whom the epiphyseal lines still are incompletely fused. In these cases it can be observed how the synostosis occurs earlier on the injured than on the healthy side. At a very early stage of the affection changes of form may occur. The first of these changes nearly always takes place in the head of the radius (Fig. 4) which increases in size, chiefly radially, until it becomes so large and bulky as to project like a balcony over the capitulum humeri which is often somewhat diminished (Fig. 8, 9). Later on the deformation gradually extends to the other articular extremities as well. Still, almost invariably it remains most strongly pronounced in the radius where it may end by assuming the character of a fully developed arthritis deformans, with great deviations from the normal shape and the formation of more or less numerous corpora libera, to such an extent that the observer might be inclined entirely to overlook the flattening or structural changes which capitulum humeri has undergone and to consider these phenomena not as remaining traces indicating the origin of the affection but merely as changes coincident with all the other manifestations of the arthritis deformans (Fig. 10, 11).

Before considering more closely the relation between the features that have thus been brought to light by the roentgenograms, and the pathologic-anatomical changes attending the affection, it may

not be out of place to describe briefly the symptomatology and general course of the latter.

In its early stages the affection is probably met with almost invariably in young persons only: most frequently in individuals who are not yet full-grown: from 12 or 13 to 20 years old. Its subjects are, as a rule, young male mechanics' apprentices or young farmhands. In by far the majority of cases the symptoms are found in the right elbow. Only 6 cases in all presented themselves for medical care owing to symptoms in their left arm, and of these 1 was left-handed, while 2 of the others had a direct injury of their left elbow. This is, however, by no means to be taken in the sense that the affection is always unilateral. In more than one fourth out of the total number of cases the roentgen-examination revealed typical changes in both elbows; but only 3 of these cases presented clinical symptoms of both sides. It is more than probable that the instances of bilateralism would have proved proportionally still more numerous, had the full number of cases been systematically examined as regards both sides, which was unfortunately done only quite recently. When roentgen-examined, the elbow presenting the symptoms does by no means in all cases show greater deviations from the normal than the other one.

Only in about one fourth of the cases could the origin of the affection be traced to some distinct injury. And there has been nothing typical even in the nature of the injuries thus traced. Some of them were indirect: like over-stretching or the too forcible throwing of a stone; others were direct: a blow on the elbow or the olecranon, or the result of being squeezed between a wall and a cart, etc. It is comparatively seldom that the immediate results of the lesion have been sufficiently serious to make the injured person "see the doctor" about it. In many cases they are quite insignificant to begin with; only gradually, little by little do the symptoms begin to manifest themselves and finally make the patient consult a physician, often months, if not years, after the determining accident has taken place. In fact, this consultation does not infrequently take place so late that the accident itself may have been entirely forgotten in the meantime and is only recollected by the patient when closely questioned on the subject.

The symptoms that first call the patient's attention to the fact that something is wrong, may be of several kinds. Sometimes it is merely a certain feeling of fatigue in the arm; most frequently it is a sensation of pain, particularly when the arm is moved, seldom in repose, and as a rule the pain is not very severe. Clearly marked symptoms of "joint mouse" are relatively rare, — perhaps on ac-

count of the place in which such a body is most liable to be found, if present at all. The case in which I found the most distinct symptoms of its presence was one in which the mouse was lying between the humerus and the ulna.

The mobility of the elbow joint is nearly always limited, mostly as regards the extension; and the more or less accidental discovery of a reduced power to execute this particular movement is frequently the cause or directing the patient's attention to his affection. Flexion, too, is often interfered with; and the same may be the case, though in a lesser degree, with the movements both of pronation and supination. Many patients say that they feel "just like a snap", when moving the joint: and sometimes — particularly in older cases — the movement is attended by a strong creaking.

In cases of comparatively recent origin the objective symptoms are not very pronounced. Besides the limited mobility just mentioned, there may be a slight muscular atrophy, and in most cases one may both see and feel distinctly a certain amount of swelling or puffiness situated lateral to the olecranon and corresponding to some extravasation or to a thickening of the capsule; some pressure-tenderness will also be noticed in that spot. Of course, the presence of a palpable corpus liberum is not at all rare; but this body is by no means present in all cases.

From the description I have given here it will be seen that the symptoms of the affection in its early stages are not very strong. Still, they may be the source of considerable discomfort, particularly when it is born in mind that the sufferers are boys or young men, to whom the possession of strong and perfectly sound arms must necessarily be a matter of the utmost importance. Even in the later stages of the affection the symptoms are very often slight, as is not infrequently seen in seriously deformed cases of arthritis.

The following is a brief report of some recorded cases, each of them being typical in itself:

Pastry-cook's apprentice, 16 years old. — Presents himself, $^{2}/_{20}$ 18 at the *Surgical Out-Patient Department of the Rigshospital* (Prof. LENDORF). Complains of pains in moving the left elbow, the mobility of which is impaired, particularly as regards extension. Symptoms began 6 months earlier. No previous trauma. Nothing abnormal observed, except for a limited mobility and a slight enlargement corresponding to the capsule on the dorsal side of the joint.

Roentgen-examination: $^{2}/_{20}$ 18. Nothing abnormal except for a clearly circumscribed rarefaction the size of a pea in the capitulum humeri. No shadow of any corpus liberum. No deformity (Fig. 12.)

$^{4}/_{12}$ 18. Rarefaction unchanged. Faintly incipient shadow of a corpus liberum between the radius and humerus (Fig. 13.)

$^{6}/_{17}$ 19. Distinct shadow, corresponding to a corpus liberum. The de-

fect in the capitulum humeri had disappeared Enlargement, particularly laterally, of the head of the radius. (Fig. 14.)

$^{10}/_{14}$ 20. Bean-sized shadow of a corpus liberum. Lower circumference of the capitulum humeri was flattened. Slight deformity and enlargement of head of the radius. (Fig. 15.)

The case was at first diagnosed tuberculosis. The patient received phototherapeutic treatment at the *Finsen Institute* and recovered to all appearances, in spite of the formation of a corpus liberum.

Although an entire absence of inconveniences is by no means rare, in spite of a corpus liberum being present, other cases may be attended with considerable discomfort:

Char-boy. Age: 15 years. — Admitted to the *Rigshospital, Dep't C* (Prof. ROVSING), $^{3}/_{8}$ 23. For about 6 months the movements of his right elbow had been uncomfortable and especially attended with occasional "snapping" in the joint. No previous trauma. The symptoms increased three weeks before his admission; a complete locking — suggesting some corpus liberum — which fixed the elbow at a right angle. On admission his arm was still in this position. It could not be extended, but further flexion was possible. Pronation and supination were unimpaired. Some swelling around the joiut, seemingly containing fluid. No palpable joint-mouse. No muscular atrophy.

Roentgen-examination: $^{3}/_{13}$ 23. Bean-sized, irregularly circumscribed defect in the cap. humeri (visible in the lateral roentgenogram as well). Shadow of corpus liberum between the ulna and humerus. The synostosis between diaphysis and epiphysis is somewhat more advanced in this humerus than in that of the healthy side. Slight deformation.

$^{3}/_{17}$ 23. Under narcosis, the elbow can be moved freely. Arthrotomy is performed. The capsule is found to be somewhat flaccid and to contain a small quantity of viscid fluid. There is a white, cartilaginous corpus liberum, and a corresponding defect in the capitulum humeri.

It is often astonishing to notice how very slight the symptoms can continue even for a great many years and in spite of considerable anatomical changes, as may be seen from the following examples:

Labourer. Age: 40 years. — Visited the *Surgical Out-Patient Dep. of the Rigshospital* for an affection of his right elbow; the origin of the injury dated back to his earliest youth, when he had strained that joint in throwing a stone. He had never been incommoded by the effects so much as to make him consult a physician about it. Only of late years had the discomfort become greater; the mobility of the elbow joint had become steadily less, particularly as regards extension, which movement can at present be executed only to an angle of 135°.

Roentgen-examination (Fig. 10, 16) showed pronounced arthritis deformans with considerable osteophytic formations and deformation, particularly of the head of the radius which is so greatly enlarged as to protrude laterally beyond the capitulum humeri where a structural change about the size of a farthing is observed a little above its lower demarcation. This change consists in a number of irregularly shaped rarefactions, mostly located to-

ward the centre, surrounded by a linear, rather sharply defined, circular shadow. In front of the joint the shadows of three corpora libera are seen, each the size of a hazel-nut.

From this roentgen picture the complete history of the affection can undoubtedly be read. In immediate relation to the trauma there has developed an "osteochondritis dissecans" probably resulting in a small fragment being gradually separated from the capitulum humeri. This has been followed secondarily by the development of an arthritis deformans which is constantly assuming larger proportions and giving rise to the formation of additional corpora libera, — unless these are all of them due to fragments dislodged from the capitulum humeri.

While the case just described was characterized by the continual presence of symptoms ever since the time of the original injury, the following case will show that this needs not always be so — or at least only to such an infinitely small extent as to pass entirely unnoticed — even though an arthritis deformans having an origin similar to that of the previous case has been stealthily developing for a score of years or more.

Chauffeur. Age: 55 years. — $^{11}/_{8}$ 22. Fell and hurt his right elbow. The injury resulted in pains, but otherwise he did not notice anything abnormal about the joint. He was not aware of anything ever having been the matter with his elbow before. As the pains continued, he visited the *Surgical Out-Patient Dep. of the Rigshospital*, whence, on $^{4}/_{9}$ 23 (i. e. 5 months after the accident) he was sent for *roentgen-examination* (Fig. 11, 17). The injured elbow showed very considerable osseous changes, especially as regards the anterior part of the articulation. The head of the radius was very much enlarged, particularly radially; the inferior contour of the capitulum humeri was markedly flattened, slightly wavy, but showed only faint structural changes. Behind the articulation between the humerus and radius, the more than bean-sized shadow of a corpus liberum was seen.

As it was very unlikely that the comparatively insignificant injury could have produced such an advanced case of arthritis deformans within this short space of time, — and as the roentgen picture, furthermore, led me to regard it as more than likely that we were really dealing with conditions arising out of an "osteochondritis dissecans" — I proceeded to question the patient more closely. It then turned out that in his earliest youth he had received an injury to "at least one of his elbows, probably the right one", and that since that time there had been some insignificant symptoms of something being wrong about that joint, more particularly in the form of a slightly reduced power of extension, together with a little "snap" in the elbow now and then. The inconveniences experienced had been so small, however, that he had

not given the matter any serious thought; not until now had his working capacity been reduced, and he had been quite able to stand the exertions of his military training.

When the roentgen picture is considered, there can hardly be any doubt but that the affection in this case was a very old one, or that a lesion of the capitulum humeri was its original source. And a further confirmation of this hypothesis is undoubtedly to be found in the fact that on examination of the left elbow, precisely the same roentgenologic and other clinical symptoms were observed there as in the right one, only in a less marked degree.

Thus, since his early youth the patient has had a latent arthritis deformans of both elbow joints, due to an "osteochondritis dissecans" and developing almost without any symptoms. But what makes him consult a physician is an accident that causes a rather acute aggravation of his condition. It may be supposed that cases of this kind would give rise to a question of considerable interest in relation to the matter of accident insurance, and they will undoubtedly be found to be by no means rare.

By the presence of a scar on the bone the cause of the affection in the last two cases described here could, in my opinion, be traced with absolute certainty to the separation of fragments from the capitulum humeri many years previously. This is not an indispensable indication, however. For, as has already been pointed out, these changes can — though it is probably rarely the case — disappear so completely in the course of time that no sign of them can be detected any longer in the roentgenogram. Only in such cases where the affection has involved the inferior portion of the articular surface of the capitulum humeri, will a more or less pronounced flattening of the lower circumference undoubtedly always remain in the latter. In other words, an arthritis deformans cubiti can quite well have its original cause in a separation from the capitulum humeri, even though the causality between such a separation and the affection revealed cannot be demonstrated with the aid of the Roentgen rays. The writer himself has seen several cases, in which these lesions were, at least from a skiagraphical point of view, completely healed without leaving any trace; and MOREAU [1] has published a case of "osteochondritis dissecans" of the knee — its location being the typical one, viz., the internal condyle of the femur — in which a consecutive series of roentgen-examinations proved the complete disappearance of the characteristic changes.

[1] Archives franco-belges de Chirurgie, vol. XXVI no. 2, 1923.

It is rather astonishing that no roentgenologist has ever made this affection which is extremely interesting just from the roentgenological point of view, the subject of a more extensive inquiry. WENDT,[1] in his work on the Roentgenology of the injuries to the elbow, does not mention it at all. Naturally, the first articles on "osteochondritis dissecans" published by surgical writers after the discovery of the Roentgen rays, treat the matter chiefly from the surgical and anatomical points of view and refer but briefly to the roentgen picture. SCHMIEDEN[2] writes that the roentgen examination can, at most, be a poor substitute for the autoptic findings, and, speaking of the corpora libera resulting from traumata and from arthritis deformans respectively, he emphasizes the greater frequency of the former cause as regards the knee-joint, while he considers the corpora libera of the elbow-joint to be due principally to the latter cause; and in support of his theory he reproduces 3 lateral roentgenograms of elbows containing corpora libera. SCHMIEDEN is hardly justified in this supposition, however. All his cases are young men, 25, 26, and 26 years of age resp., belonging to the artisan class. In one of them the affection was 10 years old; in none of them could the condition be traced to any definite, causative trauma. In other words, we are dealing just with individuals who are particularly pre-disposed to "osteochondritis dissecans" with secondary arthritis deformans of the elbow-joint. For my part, I fully believe that these patients of SCHMIEDEN belonged to the category described here and that a roentgen examination of their elbows in a ventrodorsal projection would have shown the affections to be of this character, with the typical changes in the capitulum humeri. LINDENSTEIN[3] confines himself to the brief observation that the roentgen examination is a valuable aid to the diagnosis. PREISER,[4] in 1910, published an article dealing with the pathogenesis of arthritis deformans cubiti, based on the study of 14 cases of adults and illustrated by roentgenograms of all the cases. He rejects almost completely the idea of the trauma being a causative factor and believes that the frequency of the affection must be ascribed to the "incongruous" articular surfaces shown by these roentgenograms more than to anything else. To me this theory seems quite unlikely. It is quite possible to imagine that an "incongruity" of these surfaces due to some pathological cause or other — such as Perthes' hip-disease, or a destructive (gonorrheal or suppurative) arthritism, or

[1] WENDT: Die Verletzungen des ellenbogengelenks in Roentgenogram. 1910.
[2] Arch. f. klin. Chirurgie, 1903, B. 62.
[3] Beitr. z. klin. Chirurgie, 1906, B. 25.
[4] Zeitschr. f. orthoped. Chirurgie. B. 25. 1910.

an intra-articular fracture — is the determining factor in the production of the cases of arthritis deformans which frequently occur under such circumstances; but it would be quite unreasonable, a priori, to accept a supposition that a predisposition to this disease might be found in the "incongruity" which under normal conditions exists between the articular surfaces of the humerus and the radius. In the first place, there are a great many other articulations, the surfaces of which present "incongruities" quite as large without being for that reason particularly liable to the development of an arthritis deformans; and, secondly, it must be remembered that the joint is not formed of the articular surfaces only, but that really all its soft parts are also instrumental in forming the "congruity". As a matter of fact, a closer analysis of PREISER's roentgenograms suggests a far more natural explanation of the cause, at least as regards a good many of the cases. Although the reproductions are not very clear it is nevertheless possible to distinguish in most of the volodorsal views of the capitulum humeri both a flattening and certain structural changes which are undoubtedly indications that the "osteochondritis dissecans" is responsible for the affection.

IPSEN, in "Lærebog i Kirurgi", says in regard to arthritis deformans of the elbow and to the presence of corpora libera in that joint that "even though the arthritis may be secondary, it will often be primary in its relation to the formation of corpora libera"; and that "its real cause has not been made clear". It is true that traumatic separations from "various" articular surfaces are spoken of; but the overwhelming number of separations from the capitulum humeri is not mentioned. PAYR,[1] on the other hand, points out that the traumatic corpora libera in the elbow have originated from the capitulum humeri much more frequently than from the trochlea, and sometimes from radial head; and he emphasizes the excellent diagnostic aid offered by the roentgen examination.

WILMS, in the latest edition, 1922, of "Handbuch der praktisch. Chirurgie", lays stress on the frequent occurrence of arthritis deformans cubiti and its relation to separations from the capitulum humeri. He bases his statements to a considerable extent on a paper by KAPPIS,[2] in which the latter by means of comparative clinical and autoptic examinations establishes these facts clearly and comprehensively and incidentally calls attention to the characteristic roentgenologic observations which, however, do not interest him so much as the clinical and anatomical aspects of the whole disease.

[1] Lehrbuch der Chirurgie (Wullstein u. Wilms) 1919.
[2] Deutsch. Zeitschr. f. Chirurg. B. 142. 1917.

His paper, which did not come under my notice until this paper was almost completed, opens with the remark that "although both the affection itself and its consequences are matters of general knowledge", still it has been but little mentioned and imperfectly described; and the frequency of its occurrence is by no means sufficiently recognised. It will be noticed that this statement is in entire agreement with my own observations on the subject; just as his views and conclusions regarding the symptoms and general course of the affection itself are in all essentials the same as my own.

Although it would carry us beyond the scope of this paper if we were to consider in detail the genesis of the affection, some brief mention at least must be made of the latest views on that subject and a few comparisons made between the various pathologic-anatomical changes and their visible manifestations as recorded by the roentgenograms.

"Joint-mice" — corpora libera — have been known since the time of AMBROISE PARÉ. Originally they were looked upon simply as the consequence of some cartilage or bony fragment being separated from the articular surface by some trauma or other. Later it was discovered that a trauma rarely led to the immediate formation of a corpus liberum. One of the earliest works of any importance dealing with the subject was a treatise — published in 1886 — by KRAGELUND,[1] the Danish scientist, whose results attracted but little attention to begin with, but were afterwards universally quoted. His system of classifying the different kinds of corpora libera is based chiefly on pathologic-anatomical studies of "mice" in the knee. He draws a sharp distinction between those originating from the capitula of the bones and those resulting secondarily from morbid changes in the articulation. As regards the former ones — which are the ones particularly interesting to us in connection with the subject matter of this paper — he concludes, on the grounds of their histological structure and the convexity of their cartilaginous surface, that they must be derived from the femoral condyles and probably through some fragment of the lateral portion of the internal condyle being detached as the result of some secondary process of demarcation following a trauma, as a primary, spontaneous process of this kind would be incomprehensible in this locality. The free osseo-cartilaginous sequestra increase in size through "a transformation of the spongeous tissue and a portion of the cartilaginous tissue

[1] KRAGELUND: Ledmusenes pathologiske Anatomi og Pathogenese.

into fibrocartilage, and the subsequent active, hyperplastic development of this fibrocartilage, the degree of development depending only upon the limitations of space in the joints themselves".

It was not until two years after this publication when KOENIG [1] came forward as an advocate of the concurring theory: that "mice" but rarely occur as the immediate sequel to traumata, but that their formation is most frequently due to another pathological process, which he names "osteochondritis dissecans". He then lays down 5 theses, viz.:

1. Corpora libera resulting directly and immediately from a lesion are very seldom found in such connection.

2. The separation of fragments from a free articular surface is hardly imaginable even as the result of a severe lesion.

3. On the other hand, a trauma may possibly contuse either some point of the articular surface or a portion of the nutrient vessel, by which a sequestrum is secondarily produced owing to a subsequent inflammation.

4. There exists a spontaneous "osteochondritis dissecans", to which must be ascribed the formation of most of the corpora libera hitherto considered having a traumatic origin.

5. The etiology of the osteochondritis is entirely unknown.

Ever since their publication these theses have given rise to a considerable amount of discussion and to much anatomical and experimental research. The subject has divided the authors — MARTENS, VEIT, AXHAUSEN, LINDENSTEIN, SCHMIEDEN, and many others — into two camps: some of them siding more or less unconditionally with KOENIG and maintaining the justification of his term "osteochondritis dissecans"; while others have been more inclined to agree with BARTH [2] in his scepticism as to the existence of that disease and his assertion of the trauma as the prime and most important factor in the formation of these corpora. And BARTH, too, is the first one who points out in this connection the significance of the small every-day traumata. Still, nearly all the adherents of the theory of "osteochondritis dissecans" attach great importance to the trauma as the cause of that disease and, consequently, they do not share the opinions of KOENIG quite unreservedly.

To all the authors the knee-joint appears to be the locus electus of the pathological process. It is true that the first three observations recorded in the first of KOENIG's articles deal with elbow cases; but the majority of the cases described and commented upon by

[1] KOENIG: loc. cit.

[2] Archiv f. klin. Chirurgie, B. 56, 1898.

most of the other writers are knee cases. Thus, of the 63 cases observed by BARTH 55 deal with corpora libera in the knee-joint; and as regards the elbow he sums up his conclusions in the statement that "corpora libera in the elbow-joint are mostly of pathological origin".

KAPPIS[1] is the first to point out that the elbow-joint is really the part most frequently affected; in this he is undoubtedly entirely right. While it is true that "osteochondritis" of the knee-joint is met with rather often, there can be no doubt but that the corresponding affection of the elbow-joint is many times more frequent. As a matter of fact, hardly a week goes by without our coming across one or more cases either of the affection itself or of one of its attendant manifestations in that locality.

The difficulty of arriving at some perfectly definite conclusion as to the nature and development of the affection, by means of the pathologic-anatomical examination of the cases presented, is probably due to the fact that most of these examinations have taken place at such a late stage of development that the original conditions have — owing to the latent incipiency — been obscured by secondary transformations; this is particularly true as regards the seat of the original separation. Most of the writers interpret the connective tissue formed at the seat of the fissure as a sign of the so-called osteochondritis. It seems to me that KAPPIS, in some later articles,[2] in which he takes up the whole nature and pathogenesis of the affection for a more detailed discussion, gives a much more plausible explanation of this matter. According to him, this connective tissue is simply to be compared to the connective tissue formed in pseudarthrosis, the occurrence of which is due to the disinclination of the cartilage to heal the fissures presumably caused by some trauma or other, without considering whether any such trauma can be ascertained, or whether it be one of those numerous everyday traumata that pass unheeded and to which particularly all manual workers are continually exposed. Observations have been published[3] of cases (of the knee) in which the roentgen examination showed a typical picture of "osteochondritis dissecans", but in which an operation failed to show any fissure in the cartilage, revealing only a slight discolouration of the latter at the injured spot. Not until this discoloured cartilage was removed were any subchondral changes seen, with hematomata and necrosis of the surrounding medullary tissue. It is possible — at least in a certain number of cases — that such

[1] KAPPIS: loc. cit.
[2] Deutsch. Zeitschr. f. Chirurgie. B. 152. 1920.
[3] HELLSTRÖM: Acta chirurgica scandinavica, vol. LV, fasc. II.

changes constitute the primary effect of the lesion, while the fissure does not appear until later. Spontaneous healing of these lesions does no doubt occur in rare and isolated cases; but, as a rule, the separation of a cartilaginous or osseo-cartilaginous fragment takes place sooner or later, subsequent to the formation of the fissure. The presence of this fragment as a corpus liberum can cause the development of more or less pronounced arthritis deformans with all its pathological sequels. Very rarely it may possibly become resorbed by coalescing with the synovial membrane. In a number of cases no separation of any fragment will take place, but a fissure — a pseudarthrosis — will remain whiche an also in all probability give rise to an arthritis deformans. A pseudarthrosis of this kind may persist for years, as has been proved by a number of cases recorded, for instance by KAPPIS and LINDENSTEIN, to which I am able to add the following observations of my own:

Female patient, aged 19 years. — Admitted to the *Rigshospital, Dep't D* (Prof. SCHALDEMOSE) for an affection of her right elbow in consequence of a fall 2 years previously which had caused an injury to the olecranon. After the first stage of the suffering due to the accident had been passed, there still remained some pains in the elbow-joint, the general mobility of which was also impaired, particularly as regards extension. No symptoms of any corpus liberum had ever been observed. *The roentgen examination* revealed in the capitulum humeri a bean-sized, rather distinctly circumscribed rarefaction surrounded by a somewhat denser zone. No corpus liberum, but slight deformations. No atrophy of the bones. Left elbow normal. Arthrotomy revealed a fissure in the cartilage of the capitulum humeri, and by means of a sharp spoon it was possible to remove a flap of articular cartilage about half the size of a pea. This was surrounded by a small quantity of frayed connective tissue, which also covered the site from which the fragment had been removed; and when this tissue had been scraped off, the smooth osseous tissue was seen at the bottom.

Attempts have been made to produce analogous conditions by experiments on animals, though apparently without results, owing to the separated fragments of cartilage becoming resorbed in nearly all cases.

As regards the rôle played by the trauma, it is quite comprehensible that KOENIG should take up a very sceptic attitude towards the theory of its great importance as advanced by BARTH. In opposition to the latter he asserted that, at any rate, the theory could hold good only in the case of very severe lesions; but these are absent in nearly all the cases. At the present day when — chiefly, perhaps, by the aid of Roentgen rays — we have seen so many apparently "spontaneous" fractures of sound bones (metatarsi, os lunatum, etc.) that the occurrence of similar affections involving the knee or the elbow ought hardly to cause very much astonishment.

As to my own cases, the trauma could be definitely demonstrated only in about one-fourth of them; and if we take into further consideration that the affection was bilateral as regards one-fourth of the patients, the frequency of a clearly demonstrable trauma as a causative factor becomes even less. The part taken by every-day traumata in the production of this elbow affection is clearly indicated by the fact that it is almost invariably occurring in young males from 15 to 18 years old belonging to the artisans or agricultural classes, on whose right arm (which is by far the one most frequently affected) relatively severe demands are placed just at that age. Some of these cases in which the affection was located in the left elbow, were lefthanded individuals. KAPPIS is mistaken in his statement that the affection never occurs in females. I have myself observed several such cases, besides the one just described. It can probably occur now and then also at a later age; at least, I believe that I have observed a case of this kind, due to a clearly established trauma (the lifting of a heavy load), in a carpenter aged 26. But, as already stated, it will never be possible to decide to any degree of absolute certainty whether such a trauma has not simply been the means of awakening symptoms that are in reality connected with some previous, latently developing affection. It is also extremely probable that a certain individual disposistion of an entirely unknown nature may play a part in the matter. This would seem to be indicated by the fact that a simultaneous occurrence of the affection in both elbows is by no means rare; it is probably much more common than the corresponding affection of the knee, of which I remember having seen only one single bilateral case. The affections of the knee and the elbow would seem to differ also in this respect that the former occurs as a rule in adults of more than twenty years of age. It is beyond the scope of this paper to consider in detail the other differences presented by the clinical and roengenologic features of the affection in the two localities respectively.

The affection is probably not found in any other joints but those of the knee and the elbow. Attempts have been made to class it with the affection of the second metatarsal which was first described by KOEHLER; but I believe the resemblance between the two is merely the apparent one that they both occur in young individuals, frequently without any traceable trauma and frequently resulting in an arthritis deformans. On another occasion, in a paper dealing with the metatarsal affection,[1] I have suggested that this affection

[1] Acta radiologica, vol. I.

is probably a (congenital?) anomaly in the center of ossification, similar to the one responsible for PERTHES' hip-disease and several other affections. Notwithstanding certain points of resemblance the pathologic-anatomical changes characterizing the two groups seem to me so different, and similarly the roentgen findings in the two affections seem so strongly at variance that the idea of their having a common etiology is altogether unlikely.

KAPPIS believes that the particular disposition of the cartilage to traumatic fissures, as shown by the knee- and elbow joints, may perhaps be explained on the basis of a certain anatomical resemblance between these joints: both being ginglymi in combination with rotary motion. He is possibly right in thinking them, on that account, particularly exposed to excessive strains which are liable to result in lesions of the convex articular surfaces.

How, then, is the roentgen picture explained, as compared with the anatomical findings we have described?

While the roentgenograms give a very adequate representation of the different deformities and corpora libera, according to their greater or lesser amount of calcareous matter, a curious disproportion exists between the rarefaction in the capitulum humeri and the histological structure of the separated fragment. We know that it is very rare for any but the most insignificant fragment of osseous tissue to become separated together with the cartilaginous fragment. It is therefore astonishing that we should find an absolutely distinct rarefaction in the roentgenogram of most cases; this is the case even in those instances where no separation at all has occurred. The explanation must presumably be sought in disturbances of the nutrition of the osseous tissue immediately surrounding the seat of the lesion, resulting in necrosis — with partial resorption of this tissue — in such a manner as to produce conditions similar to those attending a process of destruction. I believe that these changes can be compared to the changes observed in the case of minute bone fissures — in diaphyses or in os naviculare, for instance. When still fresh they are often invisible or only faintly marked in the roentgenplate; but after a few weeks they appear as distinct fracture lines, probably owing to necrosis and resorption of the osseous tissue nearest to the seat of the lesion. But while most other localities present conditions favourable for the formation of new osseous tissue (definite callus), the reverse is decidedly the case as regards this elbow-disease, in which the partly separated fragment of cartilage remains like a foreign body which by its presence hinders

the formation of callus, on which the union depends. If the separation is complete, a more or less thorough restoration does probably always take place in course of time, though it is hardly ever so perfect that a more or less distinct structural change cannot be observed in the roentgenogram.

It may perhaps also be a matter for astonishment that in many cases no shadow of any corpus liberum is visible even at an advanced stage of the affection. There may be different reasons for this. In the first place, no separation needs necessarily have occurred. In the second place, if a fragment has been separated, it may have become resorbed; though this is probably rare. And, finally, the corpus liberum may consist of cartilage only and for that reason not give any shadow. Even if a small portion of osseous tissue has become separated together with the otherwise cartilaginous fragment, it will, as a rule, necrotise and become resorbed. But the cartilaginous corpus liberum itself will probably always undergo certain changes during the subsequent course of the affection — either simple processes of calcification or transformations producing fibrocartilage and ossification — and as a result of these changes it will become visible by the Roentgenrays.

The *diagnosis* of the affection will, as a rule, be easy when attention has once become directed to the affection itself. But its initial stages are as yet most frequently unrecognized; this is proved by the fact that by far the greatest number of cases are referred for examination or admitted for treatment either under the diagnosis "uncertain" or "tuberculosis". The more advanced stages are diagnosed "arthritis deformans", though in most cases it is not possible in the usual clinical way to locate the point of origin of the inflammatory process.

In the earliest stages, the mere occurrence of the affection in young and otherwise healthy individuals of the artisan class, as well as the relative insignificance of the symptoms and the absence of fever and actual signs of inflammation should in themselves turn the mind in the right direction. The roentgen examination will then settle the diagnosis: first of all, the rarefaction in the capitulum humeri or the flattening of the distal contour; secondly, the more or less pronounced deformities, particularly of the capitulum humeri; eventually the shadow of some corpus liberum.

If there be no corpus-liberum shadow, the diagnosis may remain somewhat uncertain in a few cases, because the rarefaction can bear a strong resemblance to an osteitic focus; but the true character of

the affection will before long be made clear from the benign manner of its course, from the beginning process of deformation, particularly in the head of the radius, and perhaps from the appearance of a corpus-liberum shadow.

If the case be one of tuberculosis, no deformities will be seen; there will be no shadow of any corpus liberum; but in most cases there will be a pronounced atrophy of the bones; and often a narrowing of the space between the bones, with uneven and indistinct contours of their articular extremities.

In the more advanced stages of the affection the roentgen picture may possibly show simply an arthritis deformans, without giving any definite key to the point or manner of its origin; but, as a rule, the latter can be traced in the form of the structural changes which we have just spoken of, as well as in a general defective development of the capitulum humeri and a flattening or irregularity of its interior contour. I also believe the characteristic lateral enlargement of the head of the radius to be rather typical just of this form of arthritis deformans. So frequently are the changes here enumerated seen in connection with arthritis deformans that, in reviewing the roentgenological reports of 180 cases of this disease, chiefly from the last five years, we have felt justified in deciding that in no less than 130 cases (or about 70 per cent) was the existing arthritis due to fragments separated from the capitulum humeri. And it should be added that this is a minimum figure, because, as repeatedly stated, any number of the remaining cases may perfectly well have had the same point of origin, without it being possible to prove it, owing to the defect being healed so completely that no trace of its existence was any longer registered by the roentgenogram.

Of course, it will be argued that the structural changes in the capitulum humeri might possibly be secondary manifestations of the arthritis deformans. This is an argument that is difficult to disprove as regards the single, individual case; but when it has been ascertained through a series of successive roentgen examinations how the affection in a number of cases produces precisely these changes, — and when it has been possible to trace the origin of the affection to the patient's youth in many of the older cases, in which the roentgenogram showed the typical structural changes or a flattening of the capitulum humeri, — and when, finally, it is remembered that changes of corresponding nature are not observed in arthritis deformans of any other joints, then I do not believe the above conclusions to be in any way too hazardous, but that we may take it as proved that in the large majority of cases arthritis deformans cubiti is due to the separation of fragments from the capitulum humeri.

In these cases an examination should always be made of both elbows. The affection will then in a great many instances be found to be bilateral, although the patient is entirely ignorant of the fact. Since making the bilateral examination a routine we have had occasion to ascertain this, time and again. In many cases the discovery will serve as a further confirmation of the diagnosis, if any such be needed.

I dare not positively deny that fragments separated from some other place may possibly produce changes of a similar nature, but I believe it unlikely unless a lesion of the capitulum humeri has taken place at the same time, and it is owing to the latter that the radial part of the articulation is first and particularly affected.

The *prognosis* of the affection depends to a great extent on whether its proper treatment has been commenced at the right time. It is evident that an affection which frequently progresses for a number of years in such a benign, if not latent manner is in many cases observed only after having reached such an advanced stage — most likely in the shape of a severe arthritis deformans — that there can be but little hope of its yielding at all completely to any sort of treatment, and much less of its becoming quite cured. In the earlier stages the conditions are different; therefore it is fortunate when the affection manifests itself early and rather distinctly.

It is evident, also, from what has been said before, that the *treatment* must be varied a great deal according to the stage of the affection; and in any decision regarding this question the roentgen-examination will play an important part.

If there be no essential deformity but a distinctly visible defect in conjunction with a corpus-liberum shadow, arthrotomy should at once be performed to remove that corpus and its focus in the capitulum humeri should be scraped and smoothed out at the same time, lest any remaining fissures or irregularities in that locality should become the source of any recurrence, — which circumstance has been particularly emphasized both by Axhausen [1] and Kappis. In this manner the patient will probably as a rule be relieved from all further discomfort resulting from his affection.

Even if there be no shadow of any corpus liberum but only a *persisting* defect in the capitulum humeri, arthrotomy should be performed. This will not infrequently disclose the presence of a "mouse" which the roentgen picture had not revealed, or some portion of the cartilage may be found to be discoloured, or it may be found —

[1] Arch. f. klin. Chirurgie, B. 104. 1914.

more often — that a portion of the latter has become loose but not separated, — as in the case of the female patient reported above. Any such fragment should, of course, be removed and at the same time the defect in the capitulum humeri can be made even; thus, eventually, preventing the development of an arthritis deformans.

If a case does not come under treatment until a clearly pronounced arthritis deformans has already developed — accompanied, as a rule, by the presence of one or more corpora libera — an operative treatment cannot effect a cure nor does it seem indicated unless there are well defined symptoms of corpora libera being present, in which case these should, of course, be removed. In any other case the treatment ought probably to be limited to more conservative methods; and, besides, we know that many cases even with considerable deformities can be distinguished by long periods of relative absence of symptoms.

In conclusion, I wish to speak of an affection which I believe belongs to the manifestations secondarily attending the separation of fragments from the capitulum humeri, viz., the anterior luxation of the head of the radius, without any explanatory trauma (or, at most, an extremely slight one) and an accompanying great deformity and enlargement of the head of the radius.

The record of one of my cases belonging to this category is briefly as follows:

A labourer, 46 years old, was sent to me to be roentgen examined for an affection of his elbow, probably an anterior luxation. This diagnosis was found to be correct (Fig. 18, 19): it was, indeed, a dislocation of the much enlarged and deformed head of the radius which was pushed forward in front of coronoid process of the ulna and was seen in the ventro-dorsal picture to cover partly the upper portion of the ulna and the capitulum humeri, but the flexed position of the arm made it impossible to observe precisely the details of the inferior portion of the humerus. Still, there was evidently a deformity and diminution of the lateral portion of the articular surface of the humerus. The upper portion of the ulna was also very much enlarged and heavily shaped, and the shape of the trochlea had changed correspondingly. There was no shadow of any corpus liberum.

The history of the case was as follows: As long as the patient can remember, the power of flexion in the elbow joint has been impaired. This condition has developed quite spontaneously, without any trauma. It is not known whether he has also had any difficulty in extension. The affection has apparently never caused him

any inconvenience, nor has it caused him any discomfort during his military training. One week before the roentgen examination was made he hurt himself in climbing a ladder to a hay-loft, when, after having reached the top rung of the ladder, he was supporting both elbows against the floor of the loft to raise himself up. He then felt a "snap" in his right elbow, and afterwards he could not move it as freely as before. He does not think the injury caused any swelling of the joint, and on the whole the symptoms gave very little cause for alarm. On the following day an attempt at reduction was made (under narcosis), but failed. The patient was then admitted to the *Hospital of Fredrikssund* (Dr. USSING). On his admission he did not feel any pain at all. He kept his right arm flexed at the elbow, and the movements of this joint were rather free, though only between 60° and 150°, while the movements of pronation and supination were entirely unimpeded. There was a hollow at the place of the radial head; in front of the joint some portion of a bone could be felt, which was undoubtedly the articular end of the radius. There was no perceivable tumefaction of the soft parts. After another "totally unsuccessful" attempt at reduction the patient was sent to be roentgen examined (see above).

Arthrotomy was performed. The large deformed head of the radius was found in front of the distal end of humerus and had slipped out of the annular ligamentum which was lying loosely around the radius below its head. The latter was resected and the ligament which interposed itself between the humerus and the neck of the radius on flexion was cut off.

I had an opportunity of examining the patient again, about 15 months after the operation (Fig. 20). It was now possible to observe the defect of the head of the radius, besides the changes already mentioned, and to obtain a clear view of the whole region around the capitulum humeri. No articular surface whatever could be seen here; and the capitulum humeri was very much reduced in size, with flattened and somewhat uneven contours.

I believe the original starting point of the affection in this case was a lesion of the capitulum humeri, similar to the other lesions forming the subject of this discussion. Thence the process of deformation gradually spread, affecting the articular extremities and particularly the head of the radius which grew so large and bulky that it finally distended the annular ligamentum, from which it would then be apt to slip out in case of a trauma however slight. This seems to me a likely explanation. And the fact that we did not find any corpus liberum does not confute the supposition, because, in the first place, such a body may actually have been present and

have been resorbed later on, after having given rise to an arthritis deformans which has then gone on developing. And, in the second place, it is hardly necessary that a corpus liberum should have been present at all; but a simple lesion of the cartilage of the capitulum humeri may have been sufficient to start the development of an arthritis deformans which in the course of years resulted in the severe deformities just described.

I have observed four cases of this character. They puzzled me for a long while and I was rather inclined to believe them congenital. I now consider it far more likely that their origin is such as I have indicated here; especially as the congenital luxations of the radius are usually posterior and are as a rule characterized by hypoplasia and not by hyperplasia of the head of the radius.

SUMMARY. 1. The very common Arthritis deformans cubiti is most frequently due to the so-called "osteochondritis dissecans" (KOENIG) of the capitulum humeri.

2. Except in very rare instances the affection begins probably always between the ages of 12 ond 20 years; perhaps most frequently between the 15th and 18th year.

3. The origin of the affection is always traumatic, though not in the sense that it can in every instance be traced to some definite trauma. The small everyday traumata — particularly the forced extension of the elbow — are the chief causative factors. The affection occurs therefore most frequently in male apprentices of the artisan and agricultural classes, and by far most frequently in the right elbow. Still, its occurrence in the left elbow is by no means rare: and very often it is bilateral. It is also, though far more rarely, met with in individuals of the female sex. Possibly, there exists an individual disposition; but, if so, its nature is entirely unknown.

4. The trauma produces a subchondral lesion, and in most cases a fissure in the cartilage of the capitulum humeri; probably this fissure often goes somewhat into the bone. The lesion can — in rare cases — become healed in such a manner as so result in complete restitution. Sometimes the cartilage will remain fissured for a considerable length of time, even for years ("pseudarthrosis"); but in most cases a cartilaginous — or osteocartilaginous — fragment becomes separated sooner or later which, as a rule, continues to exist as a corpus liberum, and in course of time this undergoes secondary changes such as calcification, ossification, or growth. In rare instances the corpus liberum can probably become resorbed following its coalescence with the capsular ligament, in the same manner as has been frequently observed in experiments on animals. But whether a fragment has become separated or not, conditions have undoubtedly been created for the onset of an arthritis deformans which may subsequently assume more or less serious proportions.

5. In the early stages of the affection the symptoms are very slight as a rule: consisting merely in a reduced power of motion particularly as regards extension. Frequently the affection is overlooked for a long time — sometimes even for many years — owing to the slight symptoms and is only discovered accidentally or as the result of an aggravation due to some

new trauma. Still, in some rare instances even the earliest stages can be characterized by rather grave symptoms; among others, by corpora libera, — although symptoms of such bodies are remarkably infrequent in the elbow. In the later stages all the symptoms of arthritis deformans may appear, though there is often a curious contrast between the slightness of the symptoms and the severity of the anatomical changes.

6. The roentgen examination gives typical pictures of the affection in all its stages; at first, only as large or small rarefactions in the capitulum humeri; later, as shadows of corpora libera and deformities, the latter being, as a rule, most strongly pronounced in the head of the radius. Even in the gravest cases of arthritis having this origin it is possible in most instances to ascertain the point of origin of the affection either through structural changes in the capitulum humeri or by flattening of its distal contour. In a number of cases, however, the seat of the original lesion will undergo a restitutio ad integrum so completely that no trace of anything abnormal will be visible in the roentgen picture. Thus, the arthritis may quite well have originated in that locality, without it being possible to prove it by demonstration.

7. Considering that the separated fragment consists mainly of cartilage and that any persistent fissure also includes chiefly the same substance, the rarefactions in the catpitulum humeri are remarkably distinct. This contrast may probably be explained by the occurrence of secondary changes in the immediate neighbourhood of the original lesion, involving necrosis and absorption of osseous tissue. It is hardly necessary to maintain the definition "osseochondritis dissecans" in the sense of an inflammatory condition gradually marking the line of sequestration and causing the separation of the fragment. It is more reasonable to regard it, as KAPPIS does, entirely as a purely traumatic lesion.

8. In its early stages the affection will most frequently be diagnosed tuberculosis; but the symptoms are remarkably slight. In every case its true nature can probably be determined by roentgen examination. In the later stages the diagnosis of arthritis deformans is easy to make; and here, also, the roentgen-exsmination will be able to disclose its origin in most cases.

9. The prognosis depends on the proper treatment being instituted at the right time. The treatment should then consist in a removal of the corpus liberum, if any such be present, and in scraping and smoothing down of the seat of the lesion in the capitulum humeri. If there already exists a well developed arthritis deformans, the prognosis is always doubtful; and the removal of any corpus liberum should probably be undertaken only in case of there being very pronounced symptoms of its presence, and can, at its best, be only a palliative measure.

ZUSAMMENFASSUNG. 1. Die sehr häufige Arthritis deformans cubiti beruht meistens auf der sog. »Osteochondritis dissecans» (KOENIG) des Capitulum humeri.

2. Abgesehen von sehr seltenen Fällen, beginnt die Affektion wahrscheinlich immer im Alter zwischen 12 und 20 Jahren; vielleicht am häufigsten zwischen dem 15. und 18. Jahr.

3. Der Ursprung der Affektion ist immer traumatisch, obzwar nicht in dem Sinne, dass sie in jedem Fall auf ein bestimmtes Trauma zurückverfolgt werden kann. Die kleinen alltäglichen Schädigungen — besonders for-

cierte Extension des Ellbogens — sind die hauptsächlichen kausalen Faktoren. Die Affektion kommt deshalb am öftesten bei männlichen Lehrlingen der Handwerks- oder landwirtschaftlichen Berufe vor, und weitaus am häufigsten im rechten Ellbogen. Ihr Vorkommen im linken Ellbogen ist indes keineswegs selten; und sehr oft ist sie bilateral. Man begegnet ihr auch, wenngleich weit seltener, bei Individuen weiblichen Geschlechts. Vielleicht existiert eine individuelle Disposition; in diesem Falle ist ihre Natur aber völlig unbekannt.

4. Das Trauma ruft eine subchondrale Läsion hervor und in den meisten Fällen eine Fissur im Knorpel des Capitulum humeri; wahrscheinlich erstreckt sich diese Fissur oft etwas in den Knochen. Die Läsion kann — in seltenen Fällen — derart heilen, dass eine völlige Restitution eintritt. Mitunter bleibt eine Fissur des Knorpels für eine beträchtliche Zeit, selbst jahrelang, bestehen (»Pseudarthrose«); in den meisten Fällen aber trennt sich früher oder später ein knorpliges — oder osteokartilaginöses — Fragment ab, das in der Regel als freier Körper weiterbesteht und im Laufe der Zeit sekundäre Veränderungen eingeht wie Verkalkung, Ossifikation oder Wachstum. In seltenen Fällen kann das Corpus liberum nach Vereinigung mit der Gelenkkapsel wahrscheinlich resorbiert werden, in derselben Weise wie man dies häufig bei Tierexperimenten beobachtet hat. Ob sich aber ein Fragment abgetrennt hat oder nicht, sind zweifellos die Bedingungen für das Einsetzen einer Arthritis deformans geschaffen worden, die später weniger ernste Proportionen annehmen kann.

5. In den frühen Stadien der Affektion sind die Symptome in der Regel sehr leicht: sie bestehen lediglich in verminderter Beweglichkeit, besonders betreffs der Extension. Häufig wird die Affektion infolge der Geringfügigkeit der Symptome lange Zeit — mitunter selbst viele Jahre — übersehen und nur zufällig oder durch die Verschlechterung auf ein neues Trauma entdeckt. In seltenen Fällen können indes schon die frühesten Stadien durch ziemlich schwere Symptome charakterisiert sein, unter anderen durch Corpora libera — obzwar ausgeprägte Symptome solcher Körper im Ellbogen verhältnismässig selten sind. In den späteren Stadien können alle Symptome von Arthritis deformans auftreten, wenngleich oft ein merkwürdiger Kontrast zwischen der Leichtigkeit der Symtome und der Schwere der anatomischen Veränderungen besteht.

6. Die Röntgenuntersuchung gibt typische Bilder der Affektion in allen ihren Stadien; zuerst nur als grosse oder kleine Aufklärungen im Capitulum humeri; später als Schatten von Corpora libera und Deformitäten, die letzteren in der Regel am ausgesprochensten im Radiuskopf. Auch in den schwersten Fällen von Arthritis diesen Ursprungs ist es in den meisten Fällen möglich den Ausgangspunkt der Affektion festzustellen, entweder durch strukturelle Veränderungen im Capitulum humeri oder durch Abflachung seiner distalen Kontur. Bei manchen Fällen erfährt indes der Sitz der ursprünglichen Läsion eine so vollständige Restitutio ad integrum, dass keine Spur von etwas Abnormem am Röntgenbild sichtbar ist. Die Arthritis kann also sehr wohl von dieser Stelle ausgegangen sein, ohne dass es möglich ist dies zu beweisen.

7. Die Aufklärungen im Capitulum humeri erscheinen in Anbetracht dessen, dass das abgetrennte Fragment hauptsächlich aus Knorpel besteht und dass eine persistente Fissur gleichfalls hauptsächlich dieselbe Substanz betrifft, bemerkenswert deutlich. Dieser Kontrast ist wahrscheinlich durch das Vorkommen sekundärer Veränderungen in der unmittelbaren Nachbar-

schaft der ursprünglichen Läsion zu erklären, die Nekrose und Absorption von Knochengewebe bedingen. Es ist kaum notwendig, die Definition »Osteochondritis dissecans» im Sinne eines entzündlichen Zustandes aufrecht zu halten, der allmählich die Sequestrationslinie markieren und die Abtrennung des Fragments bewirken würde. Es ist plausibler sie, wie dies KAPPIS tut, gänzlich als rein traumatische Läsion zu betrachten.

8. In ihren frühen Stadien wird die Affektion meist als Tuberkulose diagnostiziert werden; aber die Symptome sind auffallend leicht. Ihre wahre Natur kann wahrscheinlich in jedem Fall durch Röntgenuntersuchung bestimmt werden. In den späteren Stadien ist die Diagnose der Arthritis deformans leicht zu stellen; auch hier wird die Röntgenuntersuchung in den meisten Fällen imstande sein, deren Ursprung klarzustellen.

9. Die Prognose hängt davon ab, ob die geeignete Behandlung zur rechten Zeit eingeleitet wird. Dieselbe soll dann in einer Entfernung des Corpus liberum bestehen, wenn sich ein solches vorfindet, und in Auskratzen und Glätten des Sitzes der Läsion im Capitulum humeri. Wenn bereits eine vollentwickelte Arthritis deformans existiert, ist die Prognose immer zweifelhaft; die Entfernung eines freien Körpers sollte dann wahrscheinlich nur in solchen Fällen vorgenommen werden, wo sehr ausgesprochene Symptome seines Vorhandenseins vorliegen und sie kann im besten Fall nur eine palliative Massnahme sein.

RÉSUMÉ. 1. La très commune «Arthritis deformans cubiti» est, le plus souvent, causée par ce qu'on appelle «osteochondritis dissecans» (KOENIG) du capitulum humeri.

2. Excepté dans des cas très rares la maladie commence probablement toujours entre l'âge de 12 et de 20 ans; peut-être le plus souvent entre la 15ième et la 18ième années.

3. L'origine de l'affection est toujours traumatique, quoique pas dans le sens qu'elle puisse en chaque cas être rapportée à un trauma exact. Les petits traumas de tous les jours — spécialement la brusque extension du coude — sont les principales causes de l'affection. Elle se présente par conséquent le plus souvent chez les apprentis mâles parmi les artisans et les agriculteurs, le plus souvent dans le coude droit. Cependant, sa présence dans le coude gauche est nullement rare; et elle est très souvent bilatérale. On rencontre aussi la maladie, bien que encore plus rarement, parmi des personnes du sexe féminin. Il se peut qu'il existe une disposition individuelle, mais, si c'est ainsi, sa nature est entièrement inconnue.

4. Le trauma produit une lésion subchondrale, et, dans la plupart des cas, une fissure dans le cartilage du capitulum humeri; cette fissure pénètre souvent quelque peu dans l'os. L'affection peut — dans des cas rares — être guérie, d'une telle manière que le résultat sera une complète restitution. Quelquefois la fissure du cartilage peut rester pour un temps considérable, mêmes pour des années («pseudoarthrosis»); mais le plus souvent un morceau de cartilage — ou de cartilage de l'os — se sépare tôt ou tard, et continue généralement à exister comme un corps libre, et avec le temps il éprouve des changements secondaires tels que calcification, ossification ou accroissement. Dans des cas rares le corps libre peut probablement être réabsorbé après sa conjonction avec le ligament de la capsule articulaire dans la même

manière qu'on a observé fréquemment dans des expériments sur des animaux. Mais soit qu'un fragment ait été séparé ou non, les predispositions ont indubitablement été créés par le début d'un arthritis deformans, qui dans la suite peut avoir des proportions plus ou moins dangereuses.

5. Dans les phases antérieures de l'affection, les symptômes sont ordinairement très insignifiants, consistant seulement en une faculté motrice réduite, surtout en ce qui concerne l'extension. L'affection est fréquemment négligée pendant longtemps — quelquefois même pendant des années — à cause de ses légers symptômes; et elle est découverte seulement par occasion ou comme le résultat d'une aggravation causée par un nouveau trauma. Cependant, dans quelques cas très rares, mêmes les phases antérieures peuvent être caractérisées par des symptômes assez graves; entre autres par corps libres, malgré que des symptômes de ces corps sont relativement rares dans le coude. Dans les phases postérieures tous les symptômes d'arthritis deformans peuvent paraître quoiqu'il y a souvent un contraste étrange entre l'insignifiance des symptômes et la gravité des changements anatomiques.

6. L'examen radiographique donne des images caractéristiques de l'affection dans toutes ses phases. D'abord seulement comme des raréfactions grandes ou petites du capitulum humeri, puis comme des difformités, lesquelles ordinairement sont le plus fortement prononcées à la tête du radius. Même dans les cas d'arthritis les plus graves, ayant cette origine, il est possible, dans la plupart des cas, de fixer le point d'origine de l'affection, ou par changements structurals du capitulum humeri ou par aplatissement de son contour distal. Cependant, dans plusieurs cas, le siège de la lésion originale peut subir un restitutio ad integrum si complet qu'aucune trace de quoique ce soit d'anormal est visible par la radiographie. Ainsi, l'arthritis peut très bien avoir son origine dans cet endroit, sans qu'on puisse le prouver.

7. En considération que les fragments séparés consistent principalement en cartilage et que chaque fissure persistante concerne surtout la même substance, les rarefactions du capitulum humeri sont très distinctes. Probablement ce contraste peut être expliqué par l'occurrence de changements secondaires dans le voisinage immédiat de la lésion originale, comprenant necrosis et absorption de tissu osseux. Il est à peine nécessaire de garder la définition «osteochondritis dissecans» dans le sens d'une condition inflammatoire graduellement marquant la ligne de séquestration et causant la séparation des fragments. Il est plus raisonnable de la regarder, comme le fait KAPPIS, comme une lésion purement traumatique.

8. Dans les premières phases de l'affection le diagnostic est fréquemment fait à tuberculose, mais les symptômes sont très insignifiants. Dans tous les cas sa vraie nature peut probablement être déterminée par radiographie. Dans les phases postérieures le diagnostic de l'arthritis deformans est facile à faire; ici aussi, la radiographie est capable de révéler son origine dans presque tous les cas.

9. Le pronostic dépend du traitement propre ayant été institué au moment juste. Le traitement doit alors consister en extirpation du corps libre, s'il y en a, et en grattant et ébardant le siège de la lésion dans le capitulum humeri. S'il existe déjà une arthritis deformans bien développée, le pronostic est toujours douteux; et l'extirpation d'un corps libre doit être exécutée seulement s'il y a des symptômes très prononcés de son existence, et il peut au mieux n'être qu'une mesure de palliation.

RESUMEN. 1. La tan corriente »Arthritis deformans cubiti» es muy a menudo motivada por lo que corrientemente se llama »osteochondritis dissecans» (KOENIG) del capitulum humeri.

2. A excepción de algunos casos muy raros la erfermedad comienza probablemente y casi siempre entre los 12 y 20 años, tal vez más a menudo entre los 15 y los 18.

3. El origen de esta dolencia es siempre traumática, si bien no en el sentido de que siempre pueda ser atribuída a un traumatismo preciso. Los pequeños traumatismos de todos los días — especialmente la distensión brusca del codo — son las principales causas de esta afección, que, como consecuencia de ello, se presenta muy a menudo en los muchachos aprendices, entre los obreros y agricultores, y más corrientemente en el codo derecho. Igualmente se ha encontrado esta enfermedad, no siendo esto raro, en el codo izquierdo y muy a menudo se presenta bilateral. La enfermedad se encuentra también, si bien muy excepcionalmente, entre las mujeres. Puede suceder que exista una predisposición individual, pero en este caso, su naturaleza es completamente desconocida.

4. El traumatismo produce una lesión subchondral, y en la mayoría de los casos una hendidura en el cartílago del capitulum humeri; esta hendidura, a menudo penetra algo en el hueso. La afección, en estos casos, puede curarse de tal manera que el resultado sea una restitución completa. Algunas veces la hendidura del cartílago puede durar un largo tiempo, en algunos casos años enteros, (»preudoarthrosis») pero lo más corriente es que una parte del cartílago. -o de cartílago del hueso- se separe, más pronto o más tarde, y continue generalmente existiendo como un cuerpo libre, y con el tiempo sufre algunos cambios secundarios, como calcificación, osificación o crecimiento. En algunos casos raros el cuerpo libre puede ser reabsorbido después de su conjunción con el ligamento de la cápsula, de la misma manera que se ha observado frecuentemente en experimentos hechos con animales. Pero, ya sea que un fragmento se haya o no separado, las predisposiciones fueron, indudablemente, creadas por un principio de arthritis deformans, que más tarde puede tener proporciones más o menos peligrosas.

5. En las primeras fases de la afección, los síntomas son corrientemente muy poco importantes, consistiendo tan sólo en una merma en la facultad motriz, sobre todo en lo que concierne a la extensión. La afección es por lo general descuidada durante un largo período — algunas veces incluso durante años — debido a que sus síntomas ligeros, y en algunos casos se descubre tan sólo con motivo de alguna agravación motivada por un nuevo traumatismo. Sin embargo, en algunos casos muy raros, incluso las primeras fases pueden caracterizarse por síntomas bastante graves; entre otros por los cuerpos libres, a pesar de que los síntomas de estos cuerpos resultan extraordinariamente escasos en el codo. En las fases posteriores, todos los síntomas de la arthritis deformans pueden aparecer, aun cuando muy a menudo existe un raro contraste entre la poca importancia de los síntomas y la gravedad de los cambios anatómicos.

6. El examen radiográfico da imágenes características de la afección, en todas sus fases. Al principio sólamente aparecen como rarificaciones grandes o pequeñas del capitulum humeri, después como deformaciones, las cuales, ordinariamente, son mucho más pronunciadas en la cabeza del radius. Igualmente en casos de arthritis muy graves, cuyo origen sea el expuesto, resulta posible, en la mayoría de ellos, fijar el punto de origen de la afección, o por

cambios estructurales del capitulum humeri o por aplastamiento de su contorno distal. No obstante, en varios casos, el lugar de la lesión original puede haber sufrido una restitutio ad integrum, tan completa que no pueda apreciarse radiográficamente la menor huella de anormalidad. Así pues, la arthritis puede muy bien tener su origen en aquel punto, sin que ello pueda probarse demostrativamente.

7. Tomando en consideración que los fragmentos desprendidos consisten principalmente en cartílago y que cada hendidura persistente contiene la misma substancia, las rarificaciones del capitulum humeri son muy claras. Probablemente este contraste puede explicarse por la existencia de cambios secundarios en las cercanías de la lesión original, comprendiendo necrosis y absorción del tejido óseo. No resulta pues necesario considerar la definición »osteochondritis dissecans» en el sentido de una condición inflamatoria que marque gradualmente la línea de secuestro, causante de la separación de los fragmentos. Es más razonable considerarla, como lo hace KAPPIS, como una lesión puramente traumática.

8. En las primeras fases de la afección, el diagnóstico se hace generalmente con carácter tuberculoso, pero los síntomas resultan muy evidentes. En todos los casos, la verdadera naturaleza puede ser, con grandes probabilidades, determinada por la radiografía. En las fases posteriores el diagnóstico de la arthritis deformans resulta muy fácil de hacer; en este caso, la radiografía puede revelar el origen en casi todos los casos.

9. El pronóstico depende del tratamiento adecuado seguido en el momento preciso. El tratamiento debe consistir en la extirpación del cuerpo libre, caso de que lo haya, y raspando el lugar de la lesión en el capitulum humeri. Si ya existe la arthritis deformans completamente desarrollada, el pronóstico es siempre dudoso; y la extirpación de un cuerpo libre debe solamente efectuarse si existen síntomas muy pronunciados de su existencia, que en muchos casos no resulta más que una medida paliativa.

THE PICTURES

Fig. 3 and 5 from the same case $^{9}/_{8}$ 20 and $^{3}/_{26}$ 23.
Fig. 4 and 6 from the same case $^{11}/_{10}$ 17 and $^{4}/_{3}$ 23.
Fig. 10 and 16 from the same case.
Fig. 11 and 17 from the same case.
Fig. 12, 13, 14 and 15 from the same case $^{2}/_{20}$ 18, $^{4}/_{12}$ 18, $^{6}/_{17}$ 19, $^{10}/_{14}$ 20.
Fig. 18, 19 and 20 from the same case $^{12}/_{17}$ 21, $^{12}/_{17}$ 21, $^{5}/_{24}$ 23.

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Fig. 1.

Fig. 2.

Fig. 3.

Fig. 4.

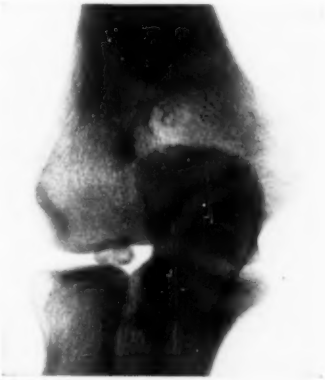

Fig. 5.

Fig. 6.

Fig. 7.

Fig. 8.

Fig. 9.

Fig. 10.

Fig. 11.

Fig. 12.

Fig. 13.

Fig. 14.

Fig. 15.

Fig. 16.

Fig. 17.

Fig. 18.

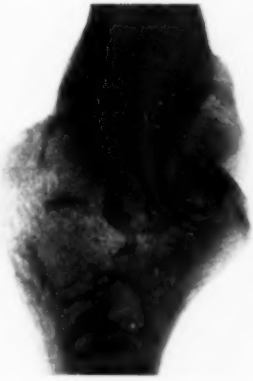

Fig. 19.

Fig. 20.

SOME EXPERIENCES OF BRONCHOGRAPHY AFTER INJECTIONS OF LIPIODOL

by

E. Danielsson and *J. Manfred*

(Tabula XVI)

The French investigators SICARD[1] and FORESTIER[2] seem to have been the very first to employ a concentrated iodine preparation dissolved in oil for taking roentgenograms of the bronchial tree. As early as in March 1922 SICARD has published capital pictures of the bronchi. After that, several other Frenchmen (as LEROUX, CLAISSE, SERRAND, SERGENT and COTTENOT[3]) have made similar roentgenograms. Opinions have differed as to whether the injections into the trachea should be done from above through the larynx or through a puncture in the trachea, but otherwise a principally uniform technique has been employed.

Our attention was first attracted to this matter by the articles in the *Paris Medical*, and in January 1923 we began experimenting with injections into the trachea after cocainization of the introitus laryngis. Only once have we introduced the syringe through the front of the thrachea, but in all the other cases we have simply managed to fill the bronchi with lipiodol, so that the bronchial tree has been beautifully outlined in the roentgenphoto.

Lipiodol Lafay is a preparation of about the same consistence as glycerine and contains 40 per cent. by weight of pure iodine dissolved in oil of cloves; one c. c. contains 0.54 gram of iodine. It is of a pale yellow colour, smells faintly of iodine, and has an oily taste. Under the microscope one does not find any undissolved crystals of iodine, not even under high magnifying power. In spite of its large percentage of iodine it does not irritate the mucous membranes and may be injected subcutaneously without causing

[1] Soc. med. des hop. 17/3 1922. — [2] Paris medical 13/5 1922; 24/6 1922. — [3] Journal de radiologie et d'electr. No. 10, 1923.

pains. The technique we have employed is as follows: After cocainization of the larynx, and especially of the epiglottis, with a 20 per cent. solution of cocain, the injection is performed on the patient who has been placed in a sitting posture. Guided by the laryngoscope one introduces the bent needle of the laryngeal syringe above the epiglottis, against the posterior surface of which the syringe may quite well be supported, and the piston is then pushed down. As the oil is rather thick, one ought to employ a syringe with a thick needle having an inner diameter of about one millimeter. By warming the syringe over a flame, the oil gets thinner and less irritating. The injection must be controlled the whole time with the aid of the laryngoscope, as the needle of the syringe easily slips to one side, when the oil will land in the stomach of the patient. The patient is told to breathe quietly and to try to suppress eventual attacks of coughing. In this manner one is able to inject five times three c. c. at a time. The total amount of oil should be at least 15 c. c.

The patient almost immediately feels that «it boils in his chest» and in addition he has a definite sensation of how the oil is flowing down into the bronchi, and in many cases he is able to localize this sensation to a definite side, where the lipoidol is afterwards found in the roentgenogram.

The roentgenograms should be taken immediately after the injection, as otherwise the oil is sucked farther and farther down into the lung by each respiration, and when the oil has entered the finest bronchioles and the alveoli, one gets diffuse shadows. When injected in this manner the oil flows down into the large bronchi towards the base of the lung. By making the patient lean to the right or left side during the injection it is possible to get the oil to flow chiefly into the right or left lung resp. To begin with we used to photograph the patient in a sitting posture, but of late we have placed the patient on his back with his head down, or on his side in an inclined position, and in this manner we have made the oil flow upwards into the upper and middle main bronchi (Fig. 3).

The lipiodol disappears very quickly from the bronchi. Already the next day one can very often not see much of the beautiful picture of the bronchial tree, only a diffuse shadow over the lung. The discomforts experienced by the patient after these injections are infinitesimal. Some patients are troubled for a day or two by an increased coughing and increased secretion from the bronchi, most of them get a slight iodism coryza. Lastly, it has happened in one case that a patient has got a rise in temperature of 0.5—0.6° C. on two consecutive occasions after injection, which increase in temperature disappeared within two days.

In one of our roentgenograms (Fig. 1) the bronchi of a lung treated for pneumothorax are seen to be quite filled with lipiodol right out to the lower lateral attachment of the adhesion where the bronchus runs directly into 2 or 3 small cavities which are probably filled with a caseous mass imbibed with iodine. As late as two months after the injection we have observed in this patient the same identical shadows of cavities, while the bronchi have been empty for quite a long time (Fig. 2). In another plate (no Fig.) the bronchial tree of a pneumothorax lung is seen to be compressed from above downwards, apparently due to an incapsulated exudate compressing the lung in this direction.

We are not able to express an opinion as to the therapeutic value of this method, but that possibility is surely not precluded that in certain cases a therapeutic effect might be produced by this harmless, powerful, local iodine treatment.

From the pictures we have produced it is also quite obvious that by this new method one gets quite a different idea of the course of the bronchi, their various lumina, and eventual dilatations, as well as of the course taken by the bronchi out into eventual adhesions in pneumothorax lungs. This latter fact might possibly be of some significance when the question arises of cauterizing the adhesions after the method of JACOBÆUS.

Since it is possible by this method, and without any discomfort to the patient, to obtain, intra vitam, such pictures of the bronchial tree, the method must be considered an improvement of the technique for diagnosing the pulmonary diseases.

SUMMARY

After injection of Lipiodol into the trachea, the authors have studied the bronchial tree in the roentgenogram, the lower as well as the middle and upper main bronchi. The communications between the cavities and the bronchi can be seen in this way right out to the attachment of the lateral adhesions. The therapeutic effect of this harmless, local iodine treatment of the bronchial tree may be discussed.

ZUSAMMENFASSUNG

Nach Injektion von Lipiodol in die Trachea haben die Verfasser den Bronchialbaum im Roentgenogramm studiert, die untern und obern Hauptbronchi ebenso wie den mittleren. Die Bronchi waren auf diese Weise, kommunizierend mit den Kavernen, bis hinaus zu den Ansätzen lateraler Adhäsionen zu sehen. Der therapeutische Effekt dieser unschädlichen lokalen Jodbehandlung des Bronchialbaums mag noch zur Diskussion gestellt sein.

RÉSUMÉ

Après injection de Lipiodol dans la trachée, les auteurs ont étudié les bronches radiographiquement, les bronches supérieures ainsi que les inferieures et médiales. Ainsi les communications entre les cavités et les bronches peuvent êtres vues jusqu'à l'attachement des adhésions latérales. L'effet thérapeutique de ce traitement local inoffensif des bronches par l'iode peut être discuté.

RESUMEN

Después de la inyección de Lipiodol en la tráquea, los autores han estudiado radiograficamente los bronquios superiores así como los inferiores y medios. De esta manera las comunicaciones entre las cavidades y los bronquios pueden apreciarse hasta la base de las adherencias laterales. El efecto terapéutico de este tratamiento local inofensivo de los bronquios con el yodo puede ser objeto de discusión.

Fig. 1.

Fig. 2.

Fig. 3.

A CASE OF ROENTGENOLOGICALLY DIAGNOSED OSTEOMA OF THE SUPERIOR MAXILLA

by

Adolf Rappe

The case relates to a 64-year-old woman, E. P., who was admitted to Radiumhemmet of Stockholm on January 16th 1924 for a tumour of the right superior maxilla.

Ever since it was first noticed about twelve years ago the tumour had grown slowly without causing any discomfort worth mentioning.

In the case records of Radiumhemmet (No. 356/24) the tumour is described as «a swelling comprising the whole alveolar process of the right superior maxilla, extending from its posterior end to the site of the canine tooth».

The patient was roentgenographed at the Roentgen Department of the Seraphimer Hospital on Jan. 18th.

A frontal roentgenogram (Fig. 1), corresponding to the lateral portion of the alveolar process, shows a well circumscribed oval

Fig. 1.

Fig. 2.

shadow the density of bone, its greatest diameter being vertical. The shadow was about four centimeters in height and two centimeters in breadth. Its upper medial portion obscures the lower lateral half of the maxillary antrum, the boundaries of which are clearly discernible.

The lateral roentgenogram (Fig. 2) shows a shadow dense as bone, five centimeters long and two centimeters broad. It extends backwards from the (still remaining) canine tooth. Its boundaries on all sides are well marked, its upper boundary being about half a centimeter below the hard palate.

Fig. 3.

Fig. 4.

In order to find out, if possible, the structure of the tumour a special roentgenogram (Fig. 3) was taken with an intra-oral film (4 by 7 centimeters). The greater portion of the tumour from the canine tooth backwards is seen in this roentgenogram. The tumour shows a distinct structure of spongious bone.

With the aid of the special roentgenogram the Roentgen diagnosis Osteoma Maxillæ dext. was made.

The patient was operated upon on Jan. 31st (by Professor G. NYSTRÖM, Upsala), when the tumour was removed with chisel.

The anatomo-pathological diagnosis (made at the Pathological Institution of Upsala) was Osteoma.

A roentgenogram of the pathological specimen (Fig. 4) shows exclusively spongious bone trabeculæ.

The case is interesting in that the diagnosis Osteoma could be made roentgenologically thanks to the distinctive structure seen in the special roentgenogram.

On looking through the Roentgen plates of the superior maxilla at the Roentgen Dep. of the Seraphimer Hospital I have not been able to find a single case in which the diagnosis Osteoma could be roentgenologically established in this manner. Nor have I been able to find any report of a similar case in the roentgenological literature at my disposal.

SUMMARY

The author describes a case of Osteoma of the Maxilla, where the diagnosis could be made with the aid of an intra-oral film.

ZUSAMMENFASSUNG

Der Autor beschreibt einen Fall von Osteoma maxillæ, bei dem die Diagnose mit Hilfe eines intraoralen Films gemacht werden konnte.

RÉSUMÉ

L'auteur décrit un cas d'ostéome maxillaire, où le diagnostic pouvait être fait à l'aide d'une pellicule intra-orale.

RESUMEN

El autor describe un caso de osteoma maxilar, en donde el diagnóstico podía efectuarse por medio de una película intra-oral.

FROM THE ROENTGEN CLINIC OF THE BISPEBJERG HOSPITAL, COPENHAGEN,
CHIEF: DR. CHR. I. BAASTRUP.

A CASE OF DIVERTICULUM OF THE JEJUNUM DIAGNOSED BY MEANS OF RADIOGRAPHY

by

Chr. I. Baastrup

Jejunal diverticula seem to be rather rare occurrences, judging from the scant number of such cases that have been published. JAMES T. CASE[1], in 1920, collected 17 cases from the literature; of these only four were single diverticula, the remaining ones being multiple diverticula. In October 1923, J. D. BUXTON[2], in the Journal of Anatomy, recorded one case of diverticulum of the jejunum. He had found 29 cases described in the literature.

In handbooks on Roentgenology one seeks in vain for information in regard to jejunal diverticula. J. T. CASE[1] was the first who diagnosed two cases of multiple diverticula of the jejunum by means of radiography. In both of these cases the diagnosis was verified by operation. The one case, in which a large diverticulum was found, bore some resemblance to the case I am going to describe in the following report. PH. H. COOK[2] has diagnosed a single jejunal diverticulum on the basis of the roentgenogram and has also had his diagnosis confirmed by operation. His case bears a very great resemblance to mine. In the literature I have not been able to find any more cases mentioned, in which the diagnosis jejunal diverticulum has been made by means of radiography. The case recorded below is thus presumably only the second case published of solitary diverticulum of the jejunum which has been diagnosed by means of Roentgen rays, and in which the diagnosis has been verified by operation.

The patient was a woman, 43 years of age, admitted to the Bispebjerg Hospital, Department A, on the 16th of October 1923, with the diagnosis: appendicitis chronica; neurastenia. Discharged on the 17th of December 1923. For two or three years she has occasionally suffered from pains in her abdomen, particularly in the left side. The attacks of pain would last only a few hours; subjectively,

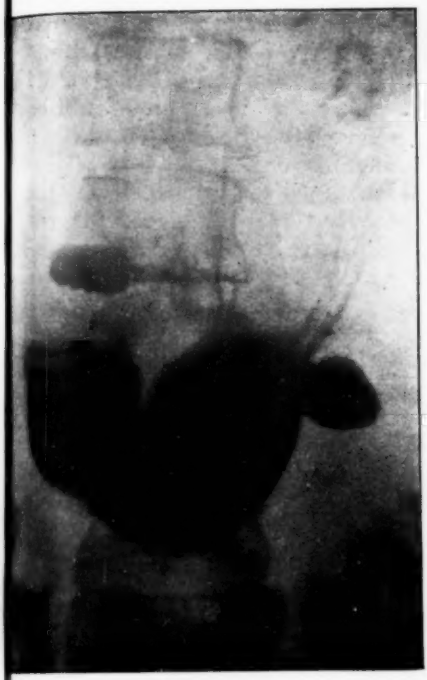

Fig. 1.

Fig. 2.

the attacks have been accompanied by fever, but there has been no vomiting. The attacks have become more frequent of late.

Objective examination of the abdomen reveals nothing abnormal except for a slight tenderness below the right curvature. There is no pressure-tenderness over MAC BURNEY'S point. EWALD'S test meal: 45—74. BOURGET'S test: (8 hours) no retention. The benzidin test gives no blood reaction; WASSERMANN test, negative.

Roentgen examination: No visible gall-stones. The stomach shows normal conditions. Tho the left of the median part of the greater curvature a small roundish barium shadow is seen immediately after the meal; $1^1/_2$ hours later this shadow is 2 by 2 cm., and 4 hours after the meal it is 3 by 2 cm.; in one of the roentgenograms the shadow is seen to have a horizontal surface. On re-photographing a few days later, the shadow was again found within the same area.

On photographing in an oblique plane the shadow is projected away from the stomach. (Fig. 2.) A stenosis of the small intestine would scarcely be supposed to exhibit such a roundish form, but rather

a more or less pronounced spindle-shape; — in different investigations the form has perhaps been somewhat varying. The surface would surely not, in case it was horizontal, exhibit the appearance found in Fig. 2. On account of the peculiar form of the shadow, and on the basis of the considerations just referred to, the case was diagnosed diverticulum of the small intestine.

An operation performed on the 7th of November 1923 (by Dr. WESSEL, Head-Surgeon of the Bispebjerg Hospital) revealed a diverticulum of the jejunum «the size of the tip of an index finger», surrounded by adherences enveloping a group of glandules, which were presumably infected with tuberculosis.

The diverticulum was interpreted as a traction diverticulum. Having detached some of the adherences, the surgeons desisted from further interference on account of the exceedingly difficult conditions prevailing. The patient felt quite well, when she was discharged.

SUMMARY. The writer reports on a case of diverticulum of the jejunum diagnosed by roentgen examination and verified by operation.

The differential diagnosis between diverticulum of the jejunum and stenosis of the intestine is briefly mentioned.

ZUSAMMENFASSUNG. Es wird über einen Fall von Divertikel des Jejunums berichtet, das durch Röntgenuntersuchung diagnostiziert und durch die Operation verifiziert wurde.

Die Differentialdiagnose zwischen Divertikel des Jejunums und Stenose des Darms wird kurz gestreift.

RÉSUMÉ. L'auteur mentionne un cas de diverticule de l'intestin grêle diagnostiquée par l'examen radiologique et verifiée par l'opération.

Le diagnostic différentiel de la diverticule de l'intestin grêle d'avec la sténose intestinale est brièvement exposé.

RESUMEN. El autor menciona un caso de apéndice del intestino delgado diagnosticado por el examen radiológico y comprobado por la operación.

El diagnóstico diferencial del apéndice del intestino delgado con la stenosis intéstinal ha sido ligeramente relatado.

LITTERATURE. 1) The Journal of the Amer. Med. Association; vol. 75, Nr. 22, 1920, pag. 1463.

2) Annals of Surgery; vol. 74, 1921, pag. 746.

For further information cf. the index of literature in:

3) Journal of Anatomy; vol. 58, October 1923, pag. 87.

STATE INSTITUTE FOR THE STUDY OF MALIGNANT DISEASE. BUFFALO N. Y.

VOLTAGE IN ROENTGEN RAY THERAPY

by

Wilhelm Stenstrom, Ph. D.

In the past, too little attention has been paid to the dosage in deep Roentgen ray therapy. When drugs are prescribed for a patient, it is important that the right quantity be used. This rule also refers to Roentgen ray treatment, and as such a treatment means a local attack of the disease, it is important to determine not only the total body dose, but also and in still higher degree, the dosage for tissues at different depths and for each organ in the path of the Roentgen ray beams. The correct measurement of Roentgen ray dosage is, however, a fairly intricate process. In the first place, each Roentgen ray machine should be standardized after it has been installed. Unfortunately, due to lack of cooperation on the part of physicians and physicists such standardization often has been neglected in the past.

For correct treatment, it is necessary to have charts which show the intensity at different depths under the skin in relation to the intensity on the skin for certain given conditions. Each chart for a particular machine is dependent upon the make of tube, filter, voltage, target — skin distance and size of field. The only one of these factors which is difficult to ascertain is the voltage between the terminals of the tube.

Ordinarily, the voltage is measured with a voltmeter. This is either connected to the primary coil of the transformer (or induction coil) or to a special voltmeter coil on the iron core of the transformer (induction coil). The voltage between the terminals of the secondary coil of the transformer (induction coil) is supposed to be proportional to the voltmeter-readings. The proportion may, for instance, be 1,000 : 1. In that case, 50 on the voltmeter means 50,000 volts between the terminals of the secondary coil. 100 means 100,000 volts and so on. Is this, under all conditions, true? Suppose that it is true, when the machine delivers 4 milliamperes; then it is not

necessarily true when 8 M.A. are delivered. As a matter of fact, the proportion between the voltmeter-readings and the secondary voltage of the transformer is for most Roentgen ray machines dependent upon the milliamperage. With one of our machines, we are working either with one tube and 8 M.A. or with two tubes and 8 M.A. through each one. In order to obtain 200 K.V. (200,000 volts) both times we must make the meter read 208 in the first instance, and 218 in the second. If we had relied upon the voltmeter-readings alone without «checking them up» we would have had too low voltage in both instances, and would have given a smaller dose in the second instance than in the first. The conclusion is that the voltmeter must be calibrated by means of another method for measuring voltage between the terminals of the tube. It is, however, not sufficient to calibrate the voltmeter once for all, for the milliamperage that is going to be used. One day while using one tube, we found that the voltmeter-reading had to be increased to 224 before 200 K.V. was reached. After careful cleaning of the commutator of the synchronous motor and all insulators supporting the aerial, 200 K.V. was reached again at a voltmeter-reading of 208. Another time we could obtain but 150 K.V. at a reading of 230 and concluded that there must be a short circuit of a part of the secondary coil. This proved to be correct.

Before further discussion of measurements, it is necessary to consider the variation of voltage with time. If a transformer is used, the fluctuations of the voltage in the primary coil will be represented by a sinus curve (A Fig. 1). With 50 cycle current 50 such waves as curve a-b will pass through the coil per second. The usual voltmeters do not show these fluctuations because the inertia of the indicators is too great; they register instead the effective value of the voltage. A voltmeter made for direct current used in this circuit must, therefore, register zero as the quantity of negative voltage is always equal to that of the positive. A voltmeter for alternating current will register the effective value of the positive voltage plus the effective value of the negative voltage, or in other words, twice the effective value of the positive voltage. This is shown in Fig. 1 C. According to mathematical calculations, the maximum value c of the sinus curve is equal to 1.41 times the effective value d. An instrument can, therefore, be calibratad just as easily to read the maximum (crest) voltage as the mean (root effective square) voltage. The voltage fluctuations in the secondary coil are supposed to be proportional to those in the primary coil. This is, however, not quite true when a considerable current is taken from it, therefore, the voltmeter can not be a true indicator of the voltage between

the terminals in the secondary coil. The deviation is more marked when the current through the primary coil is controlled by an autotransformer than when by a resistance.

The current from the secondary coil must be rectified before passing through the Roentgen ray tube. In the rectifying device some of the voltage is lost, and in the aerial between the rectifier and the tube, another voltage drop is produced due to corona and other leakage. A mechanical rectifier changes the form of the voltage curve considerably and the maximum voltage at the outlet is dependent upon the setting of the arms (or disk) and the condition

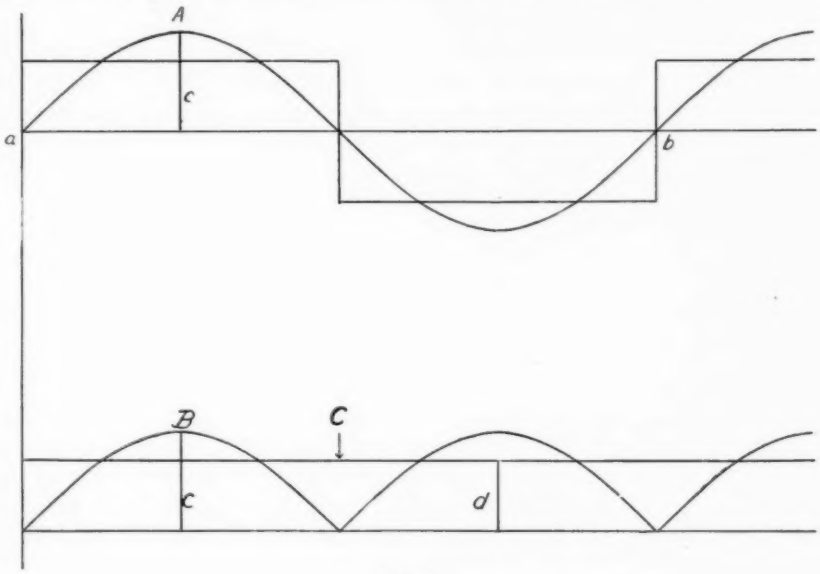

Fig. 1.

of the synchronous motor. It is worth mentioning here, that for each milliamperage, there is a certain setting of the rectifier which will give the best output. All these factors combine to make the voltmeter-readings unreliable in the measurement of the voltage on the tube.

The next instrument to be considered in the measuring of tube-voltage is a static voltmeter attached to the aerial near the tube. Such an instrument is undoubtedly very useful if carefully calibrated. However, it cannot be relied upon alone for two reasons: (1) It may change in sensitivity and need renewed calibration. (2) Its

readings are proportional to the effective voltage while the Roentgen ray output is proportional to a value which lies closer to the maximum voltage. The maximum voltage has also been widely accepted as the standard voltage for deep therapy.

The maximum voltage can easily be measured by means of a spark-gap and a voltmeter, but care must be taken that the readings are made correctly. The primary voltmeter should be calibrated often, by means of the spark-gap for the milliamperage used. In U. S. A. the sphere-gap has been preferred to other spark-gaps for the following reasons: (1) No corona surrounds the balls and the first spark, therefore, is sharp and distinct and can be stopped only by reducing the voltage or increasing the gap considerably. There is no doubt at which point it starts (a single cracking now and then may be produced by surges but it cannot be mistaken for a real spark). It can be repeated time after time with exactly the same readings on the primary voltmeter and little is left for personal opinion. The points in a point gap become surrounded by corona already at a low voltage; a brush discharge sets in, which increases with voltage and goes over into a light, undefined crackling now and then. This comes more often as the voltage is further increased and finally changes to a continuous lightning. It is left to personal opinion when it should be defined as a spark. (The corona discharge and too much sparking should be avoided during treatment as it produces ozone and oxides of nitrogen.) Furthermore, the sparking distance depends upon whether the points are sharp or dull. (2) The sphere-gap has been carefully calibrated in relation to voltage and the dependence of the length of the gap upon temperature and barometric pressure has been determined. The standard table in the United States for relation between diameter of spheres, spark-gap and voltage at 25° C. and 760 mm. mercury pressure is published in the Standards of the American Institute of Electrical Engineers[1] (New York 33 West 39th St.) and is reproduced here in Table I. The crest voltage is usually referred to in Roentgen ray treatment instead of effective voltage and has, therefore, been added here to the table (column 1).

The spark-over voltage for a given gap decreases with decreasing barometric pressure and increasing temperature. The voltage for any temperature and any barometric pressure can be computed from Table 1 simply by multiplying the voltage given there by a correction factor. This factor is determined by the relative air density d. It is approximately equal to d for values of d between 1.9 and 1.1. — d is computed

[1] For necessary precautions see this book.

Table I

Sphere — Gap Spark — Over Voltages

(At 25° C. and 760 mm. Barometric pressure)

Sparking Distance in Millimeters

Kilovolts		62.5 mm. spheres		125 mm. spheres		250 mm. spheres		500 mm. spheres	
Crest	Effective	One sphere ground	Both spheres insul.	One sphere ground	Both spheres insul.	One sphere ground	Both spheres insul.	One sphere ground	Both spheres insul.
14	10	4.2	4.2	—	—	—	—	—	—
28	20	8.6	8.6	—	—	—	—	—	—
42	30	14.1	14.1	14.1	14.1	—	—	—	—
57	40	19.2	19.2	19.1	19.1	—	—	—	—
71	50	25.5	25.0	24.4	24.4	—	—	—	—
85	60	34.5	32.0	30.0	30.0	29	29	—	—
99	70	46.0	39.5	36	36	35	35	—	—
113	80	62.0	49.0	42	42	41	41	41	41
127	90	—	60.5	49	49	46	45	46	45
141	100	—	—	56.0	55	52	51	52	51
170	120	—	—	79.7	71	64	63	63	62
198	140	—	—	108.0	88	78	77	74	73
226	160	—	—	150	110	92	90	85	83
255	180	—	—	—	138	109	106	97	95
283	200	—	—	—	—	128	123	108	106
311	220	—	—	—	—	150	141	120	117
339	240	—	—	—	—	177	160	133	130
368	260	—	—	—	—	210	180	148	144
396	280	—	—	—	—	250	203	163	158
424	300	—	—	—	—	—	231	177	171
452	320	—	—	—	—	—	265	194	187
481	340	—	—	—	—	—	—	214	204
509	360	—	—	—	—	—	—	234	221
537	380	—	—	—	—	—	—	255	239
566	400	—	—	—	—	—	—	276	257

from the equation $d = 0.392 \times \frac{b}{273 + t}$; where b is the barometric pressure in mm. mercury and t the temperature in degrees centigrade. The correction factors thus computed for temperatures between 0° and 35° C. at 760 mm. pressure and for barometric pressures between 700 and 800 mm. mercury at 25° C. are given in table II.

Table II

b = 760 mm. Hg.			t = 25° C.		
t	d	K.V.	b	d	K.V.
0° C.	1.092	218	700	0.9211	184
5	1.072	214	710	0.9392	187
10	1.053	211	720	0.9474	189
15	1.035	207	730	0.9605	192
20	1.017	203	740	0.9737	195
25	1.000	200	750	0.9869	197
30	0.9835	197	760	1.000	200
35	0.9675	193	770	1.013	203
5° C. = 3.5 K.V.			780	1.026	205
10 mm. Hg. = 2.7 K.V.			790	1.040	208
			800	1.053	211

t = temperature in contigrades; d = air density = correction factor (approx.); b = barometric pressure in mm. mercury; K.V. = kilovolts at this pressure and temperature.

Table III is given as an example of a table for practical use in an Roentgen ray room. It is made for a place with an average temperature of 25° C. and barometric pressure of 741 mm. mercury (Buffalo) and 200 K.V. is supposed to be the voltage ordinarily used.

Table III

Sphere — Gap Spark — Over Voltage

at 25° C. and 741 mm. barometric pressure (Buffalo)

Sparking distance in mm. between 125 mm. spheres both (insulated)

Crest K.V.	mm. spark
40	13.8
55	18.9
70	24.5
85	30.7
100	37.5
120	46.6
140	56.5
160	67.3
180	79.0
200	93.0

Correction factor of K.V. for 5° C. 1.017

» » » » » 10 mm. Hg. 1.013

200 K.V. mm. pr.	25° C. mm. spark	200 K.V. Temp.	741 mm. pr. mm. spark
770	87.0	15° C.	87.4
760	89.0	20	90.2
750	91.1	25	93.0
740	93.2	30	95.8
730	95.3	35	98.6
720	97.5	—	—
710	99.7	—	—
Diff. for 10 mm. pr. = 2.1 mm. sp.		Diff. for 5° C. = 2.8 mm. sp.	

The relation between spark-gap and voltage at 741 mm. pressure and 25° C. is given in graphic form i Fig. 2.

The inaccuracy of a sphere-gap should not exceed 2 % if the precautions given in the «Standards» are taken. Recently, Prof. DUANE[1] has compared sphere gap measurements for Roentgen ray apparatus with readings of a carefully calibrated electrostatic voltmeter. The deviation of the values obtained with the first method from those obtained with the second method is less than 2 %.

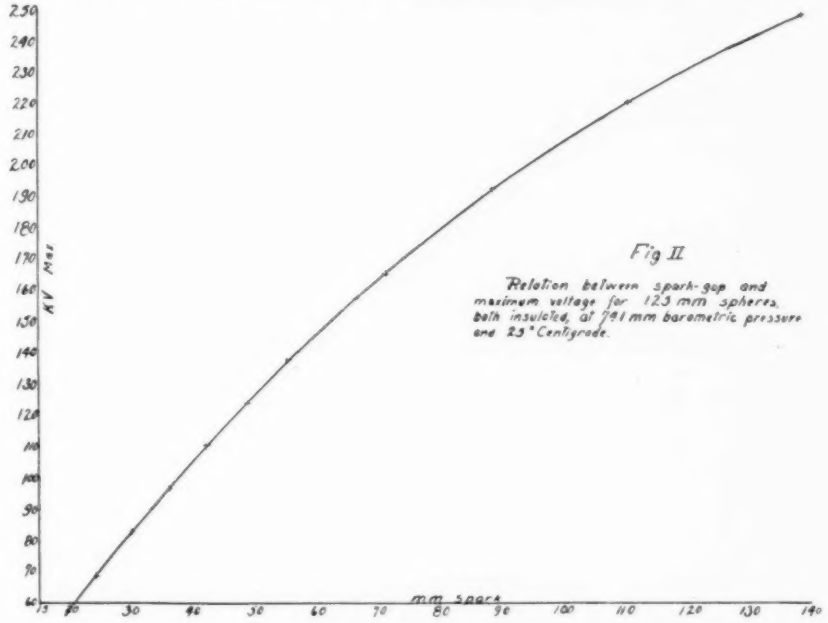
KV Max
mm Spark
Fig II
Relation between spark-gap and maximum voltage for 125 mm spheres, both insulated, at 741 mm barometric pressure and 25° Centigrade.

Fig. 2.

It is necessary to have a resistance of several million ohms in series with the spark-gap, otherwise the spark will draw too much current. Distilled water in a U-shaped glass tube can be used for this purpose but resistance rods are better. The spark-gap should in any case be placed between the milliammeters and the rectifier so that the spark-current does not pass through the former. On the other hand, it should be kept as close to the tube as possible so that the drop in voltage between the spark-gap and the tube is reduced to a minimum. Besides being an instrument for measuring

[1] Journal. Roentg. 9, 1922, p. 395.

voltage, the spark-gap is used for the purpose of protecting transformer and tube against too high voltage. It, therefore, ought to be set for a voltage not exceeding that used during the treatment by more than 20 K.V. If a fixed scale is used to measure the spark-gap then it is important that the position of the zero point is often checked and readjusted. Another method of measuring the gap, is to slide a rod of the right length for the desired voltage between the spheres (an inside micrometer is more convenient than a rod).

The spark-gap is recommended for every Roentgen ray machine in conjunction with one other instrument for measuring voltage, because it is durable and simple to adjust. At the same time, it is essential as a protection against too high voltage.

The quality and the intensity of the Roentgen rays from a certain machine and tube are determined by filter, voltage and milliamperage. It must be kept in mind, however, that it is necessary to measure the effect of the Roentgen rays when different machines or different kinds of tubes are compared. With the help of an Roentgen ray spectrograph, the distribution of the intensity over the whole spectrum can be determined. Though such measurements are necessary for certain research work, it must be admitted that they are of little importance and too troublesome to be bothered with for ordinary treatment work. However, a simple kind of spectrograph is now on the market with which the short end limit of the spectrum and the wave-length of maximum intensity can be easily determined and they are undoubtedly helpful for accurate work. The short end limit of the spectrum determines the maximum voltage that has actually been applied to the tube. This can be calculated from the equation $V_{max} = \frac{12.35}{\lambda_{min}}$ where λ_{min} is the shortest wave-length produced, measured in Ångström units, and V_{max} is the maximum voltage applied to the tube in kilovolts. The intensity of the Roentgen ray beam is most satis factorily measured with the help of an ionization chamber. This instrument can also be used to determine the mean or effective wave-length as shown by Professor Duane[1] and can thus to a certain extent take the place of the spectrograph for routine work.

SUMMARY

1) The sphere-gap ought to be generally accepted as the standard instrument for measuring voltage in deep Roentgen ray therapy, and should, at the same time, be used for protection against too high voltage.

2) Ionization chambers should be used for standardizing machines and tubes.

[1] Journal. Roentg. 9, 1922, p. 788.

ZUSAMENFASSUNG

1) Funkendistanzmessung zwischen kugelförmigen Konduktoren sollte allgemein als Standardvorrichtung zur Messung der Voltzahl in der Röntgen-Tiefentherapie akzeptiert und gleichzeitig als Schutz gegen zu hohe Spannung angewendet werden.

2) Zur Standardisierung von Apparaten und Röhren sollten Ionisationskammern zur Verwendung kommen.

RÉSUMÉ

1) L'éclateur à boules devait être généralement accepté comme instrument universel pour mesurer le voltage en radiothérapie profonde et en même temps utilisé dans un but de protection contre un voltage trop élevé.

2) La chambre dé ionisation devrait être employée en vue de standardiser les machines et les tubes.

RESUMEN

1) El rompedor de bolas debería ser generalmente aceptado como instrumento universal para medir el voltaje en radiografía profunda y al mismo tiempo utilizado como protector en caso de una sobre carga del voltaje.

2) La cámara de ionización debería emplearse para standardizar las máquinas y los tubos.

FROM THE ROENTGENEOLOGICAL DEPARTMENT OF THE ACADEMICAL HOSPITAL, UPSALA.
CHIEF: DR. HUGO LAURELL

AN APPARATUS FOR MAKING SKETCHES OF RADIOGRAMS

by

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Assistant at the Roentgenological Department

A sketch to illustrate the written description of the Roentgen ray examination is often of great value to the physician who receives the patient from the radiologist. It makes it easier for him to read the radiograms. In many cases the sketch makes it unnecessary for him to see the radiograms. It quickly gives him an idea of what the radiologist considers essential. It gives a more vived impression of the nature and extension of the changes than a mere dry description does. Further it can be affixed to the case history report and be of great value for comparisons between the result of earlier and later investigations.

It is of great value to the radiologist, too. It compels him to scrutinize the radiograms while drawing them, by which many little details which are otherwise easily overlooked force themselves upon him; further it facilitates the description and enables the radiologist to make it shorter than in case of a description whithout a sketch. Finally, by making of the sketch the image is better fixed in the memory.

To facilitate the making of sketches and to give the sketch the exact proportions the apparatus described in the following page has been devised. One of its parts is a painted-black tin-box open at the front and containing two mirrors (see fig. 2, a, b), a lower one directed forwards and somewhat upwards and an upper mirror directed backwards and also somewhat upwards. By reflection in these mirrors the light from the radiogram in the illuminator will be reflected upwards. The image of the radiogram in the upper mirror will thus be directed downwards. The image will be erect, the light having passed through two mirrors. The mirror-box is

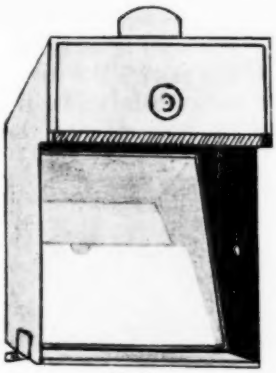

Fig. 1.

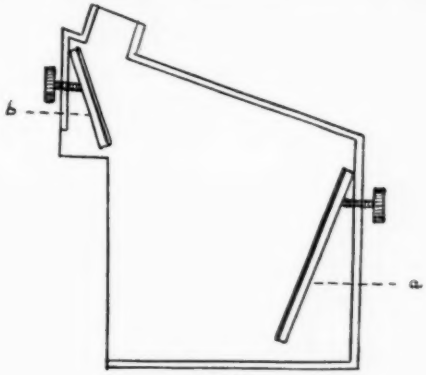

Fig. 2.

fixed on a stand connected with a drawing-board (see fig. 3). The other part is an apparatus for drawing, such as is used to make sketches of images in a microscope and which is sold by Reichert and Leitz, for instance. It is fixed immediately above the upper mirror.

The size of the mirrors can of course be ordered at pleasure, for practical purposes they have been given the following dimensions: 6 by 6 cm. (the bottom mirror) and 6 by 3 cm. (the top mirror). The top mirror is placed 8 cm. in front of the bottom mirror. The mirrors can be placed at different angles (to focus images of objects on a different level) by means of screws and fixed to the screws with springs. To make it possible to view the image there is a hole in the top of the box above the upper mirror. The edge of the window has a ring-shaped groove in which to fix the Reichert apparatus for drawing. This ring-shaped groove has been given an inclination of 10° towards the horizontal plane, the angle opens forward so as to make it easier to view the image and also to obtain a greater

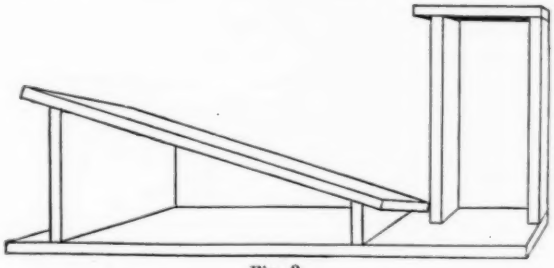

Fig. 3.

visual angle. The drawing-board is fixed on the foot of the mirror-box and immediately to the right of it. The foot is 20 cm. high.

To give exact proportions to the details of the sketch the drawing-board has been given an inclination of 10° backwards and towards the foot of the mirror-box (the angles open forward and to the

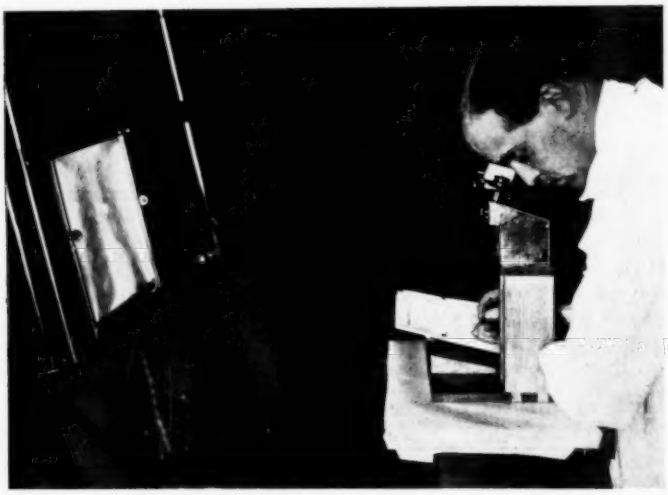

Fig. 4.

right). Of course the sketch can be given exact proportions only when the radiogram is placed perpendicularly on about the same level as the mirror-box and straight in front of it, (provided the apparatus stands on a horizontal table).

The sketch is made in the same way as a sketch of an image in a microscope (fig. 4). Thanks to the Reichert apparatus (the most important parts of which are a revolving mirror on a shaft and a prismatic mirror) the image of the paper fixed on the drawing-board as well as that of the hand and pencil will be seen when viewed through the hole in the top of the mirror-box, at the same time as the image of the radiogram focussed in the mirror. Thus, one can quickly sketch the main features by following the outlines of the radiogram with the point of the pencil. The fine details of the sketch are generally more easily completed by free hand.

The reduction depends on the proportion between the distances the light travels from the radiogram and the drawing-board to reach

the eye. Variations of the reduction are most easily obtained by focussing the apparatus at different distances from the radiogram. The apparatus is made by Mr HALVARSSON, Preparator, and Mr LILJEDAHL at the Physiological Institution at Upsala.

SUMMARY. The author describes an apparatus for making sketches of radiograms. By means of two mirrors enclosed in a box (figs. 1 and 2, a and b) a reduced erect image of the radiogram is obtained. A sketch of this image is made by means of an apparatus for making sketches of images in a microscope (for instance of REICHERT's or LEITZ's manufacture) as shown by fig. 4. The author emphazies the value of sketches of radiograms for the case history reports and for illustrating statements to be sent to other physicians.

ZUSAMMENFASSUNG. Der Verfasser beschreibt einen Zeichenapparat für Abzeichnung von Röntgenplatten. Mit zwei Spiegeln, welche in einem Kasten, der in seinem vorderen und teilweise auch in seinem oberen Teile offen ist, eingeschlossen sind, erhält man ein verkleinertes aufrechtes Bild der Röntgenplatten. Dieses Bild ist mit Hilfe eines Zeichenapparates für Mikroskop (z. B. von REICHERT oder LEITZ) gezeichnet, wie aus Fig. 4 hervorgeht. Der Verfasser erklärt es für sehr wichtig, das der Röntgenolog das Gutachten mit Zeichnungen des untersuchten Objektes illustriert. Diese Zeichnungen entlasten die Beschreibung und unterstützen ihr Verständnis. Wenn sie der Krankengeschichte beigelegt werden, wird dadurch auch die Vergleichung zwischen früheren und späteren Resultaten erleichtert.

RÉSUMÉ. L'auteur décrit un appareil à dessiner des radiogrammes. A l'aide de deux miroirs, enfermés dans une boite ouverte vers le devant et en partie aussi en haut, on obtient une image droite réduite du radiogramme. Avec un appareil dessinateur pour microscopes (par exemple de fabrication REICHERT ou LEITZ) on reproduit cette image de la manière qu'on voit fig. 4. L'auteur souligne l'avantage pour le radiologue d'illustrer avec des dessins l'exposé du résultat de ses recherches. Ces dessins facilitent la lecture et la composition de l'exposé. Ajoutés à l'observation de l'hôpital, ils rendent la comparaison plus facile avec des résultats antérieurs.

RESUMEN. El autor describe un aparato para dibujar los radiogramas. Con la ayuda de dos espejos, cerrados en una caja abierta por la parte delantera y algo en la parte superior, se obtiene una imagen recta reducia del radiograma. Con un aparato dibujador para microscopios (por ejemplo los fabricados por REICHERT o LEITZ) se reproduce esta imagen de la manera que se vé en la figura 4. El autor subraya la ventaja para el radiólogo de poder ilustrar con dibujos la exposición del resultado de sus investigaciones. Estos dibujos facilitan la lectura y la composición de la exposición. Unidos a la observación del hospital, hacen más fácil la comparación con resultados anteriores.

FROM THE ROENTGEN CLINIC OF THE BISPEBJERG HOSPITAL. (COPENHAGEN)
CHIEF: CHR. I. BAASTRUP

ROENTGENOLOGICAL STUDIES OF THE INNER SURFACE OF THE STOMACH AND OF THE MOVEMENTS OF THE GASTIC CONTENTS

Paper read at the Third Congress of the Nordisk förening för Medicinsk Radiologi, Stockholm, June 1923

by

Chr. I. Baastrup

I. Theory and Technique

The opaque meal, consisting of a mixture of opaque substances (barium sulphate, various bismuth salts, kontrastin, etc.) in a transparent medium (different kinds of pap, oat-meal gruel, mondamin cocoa, water, butter-milk, marmelade, etc.) will undoubtedly always be employed as the standard method in roentgen examination of the stomach. But, even though this meal affords an invaluable help in diagnosing diseases of the stomach, this mode of procedure has nevertheless its drawbacks:

1) the massiv shadow of the stomach gives only slight information as to the conditions of the walls of the organ, beyond their mere silhouette. Occasionally one may see, above the massive shadow of the pap, some striated or reticular formations produced by the opaque meal which has settled on the folds of the mucous membrane. If we desire to examine the anterior and posterior walls of the stomach further, we must try to obtain the desired information by placing the patient in different positions, lateral, dorsal, or ventral, or by making the exposures in various planes.

Attempts have been made to obtain pictures of the inner surface of the stomach [1] by administering to the patient in a recumbent po-

[1] The article of RENDICH: Amer. Journ. of Roentgenol. July 1923 was published after this paper was read.

sition a meal containing some opaque substances. If the patient is then made to stand up quickly and a roentgenogram is taken immediately, those residues of the meal that are still adherent to the mucous membrane may be detected in the picture. This method seems, however, not to have been used very extensively owing to the fact that it is not possible to get a picture of an inflated stomach. Neither will a picture obtained in this way do away with the inherent drawback of the Rieder meal, mentioned under 2).

2) Apart from the first mouthful, *the Rieder meal affords no opportunity of examining the movements of the swallowed food inside the stomach.* The first mouthful swallowed by the patient will settle in a triangular shape just below the collection of air in the cardiac portion of the stomach; when the patient eats more of the opaque meal, the shadow of the pap in the stomach will be seen to extend first in the longitudinal and then also in the transverse direction, but there is no possibility of studying the relative positions and movements of each separate mouthful of food and those of the food previously swallowed.

For the elimination of these drawbacks of our technique of examination various methods might be suggested:

A picture of the inner surface of the stomach might be obtained by making *an opaque substance settle as a deposit on the wall*, while the other parts of the cavity are filled with A) *air* or B) *some emulsion or pap.*

A. *Roentgenograms of the inner surface of the stomach, taken while the cavity of the organ is inflated with air.*

At the Congress of the Northern Association for Medical Radiology in Copenhagen, September 1921, LAURELL (Upsala) showed a roentgenogram of a colon, taken while the intestine, previously half-filled with barium enenia was inflated with air. The current of air blown in had thrown the pap on to the walls of the colon, the result being a very fine picture of the intestinal wall. LAURELL mentioned that similar pictures could be obtained by employing air and dry barium powder; however, he did not show any pictures to prove his assertion. I adopted this idea in regard to the stomach. Owing to the specific conditions prevailing here I believed, however, that the method by which the organ is inflated with a current of air saturated with powder would be preferable to the method of employing a barium meal. Bismuth carbonate proved more serviceable than barium sulphate. The object is to make the opaque powder settle on the moist walls of the stomach and thus to render them visible in the

roentgenogram. A tumour, or a cicatrix from an ulcer, might be thought to give characteristic pictures, as the powder, by settling down on the tumour or on the cicatricial folds, would render them visible. *Fig. 1*, shows a roentgenogram of an excised stomach inflated with air and powder. A scar formation was visible on the surface of the greater curvature. The bismuth powder deposited on the cicatricial folds forms lines which point in the direction of the cicatrix itself. This cicatrix was no doubt due to an old ulcer.[1] Owing to its being decayed, the mucous membrane did not have the folded and furrowed appearance usually seen.

The difficulties encountered in the practical application of this method are, however, very great.

The quantity of air which a normal stomach can receive, when the individual stands erect, is but slight and insufficient to carry the necessary amount of bismuth powder. (In order to determine the latter I used one-litre-bottles, the inside of which had been moistened with glycerine. I injected bismuth powder into these bottles, afterwards radiographing them through a person. In this way I fixed the minimum amount of powder required to render the stomach wall visible at 2 grams).

A double rubber tube must therefore be applied, consisting of an in-going and an out-going part, of which the out-going one may be connected to a water resistance.

Another great difficulty in this air-powder method is the shape of the end of the tube. The point of a usual stomach tube will not allow of a uniform distribution of the powder. A tube that is open below will gather mucus on its way through the oesophagus, and this mucus will in its turn catch the powder. The point of a rubber tube with many perforations will produce denser patches just opposite the holes and, moreover, it is difficult to cleanse. The best solution of this problem seems to me to be a round rubber stopper mounted on the bulbous extremity of a probe. During its passage through the oesophagus the stopper will keep the mouth of the tube closed. The tube being down, the stopper should be pushed some distance out from the mouth of the tube.

[1] Ulcer of the greater curvature is, as is well known, a very rare affection cf. also pag. 190 in this paper, where I quote several authors who hold the opinion that a gastric ulcer is *always* localized to the region of the lesser curvature. FR. WALTER, in Fortschr. a. d. geb. d. Røntgenstr. Vol. 31, Fasc. I, Pag. 14, has recorded a case of ulcer of the greater curvature. He cites statistic from 1914 (FINSTERER & GLESSNER), according to which 36 such cases have been published. The case here mentioned, which I have used for the demonstration of the »air-powder-method», is thus in itself of casuistic interest.

I will, however, not go further into details as to these difficulties, all of which can, no doubt, be overcome; but many patient and troublesome experiments will be necessary before this method can be finally perfected.

The chief advantage of this air-powder method is the fine pictures that will be obtained by the contrast of the powder against the air shadow.

The disadvantages lie in its difficult technique and in the fact that the pictures will not represent the stomach in a normal condition, (since it is inflated with air and the mucous membrane is coated with dry powder). Furthermore, the progress of the food inside the stomach cannot be studied, and the method may be dangerous in cases of ulcer.

B. *Roentgenograms of the inner surface of the stomach, taken while the cavity is filled with food having the consistence of pap.*

SCHEUNERT, ELLENBERGER, SICK, PRYM and TOBLER, and more especially GRÜTZNER, have shown by experiments on animals that *the food last ingested gets inside of the food previously partaken of, without* immediately mixing with the latter, so that the food inside the stomach becomes stratified. In 1911, KAUFMANN and KIENBÖCK pronounced that the same law obtains for human stomachs. Provided this is true, the problem we are concerned with here will be *to make the layer of food which settles in the stomach against the wall of the cavity, that is to say the first mouthful, produce a shadow and form only a thin layer while the food that is given afterwards should consist of some transparent substance.*

This view proved correct. I succeeded in obtaining pictures that were evidently due to barium meal deposited on the stomach wall. (Fig. 2 etc.)

My method is as follows:

The patient, who is fasting, should first swallow about half a *tablespoonful of a mixture* (very carefully mixed in order to avoid clumping) consisting of *about equal parts of barium sulphate and rice-meal porridge* or a thick pap of *barium sulphate and water. Immediately* on swallowing this the patient should have about 200 to 250 grams of ordinary thick rice-meal porridge (powdered cinnamon and sugar may be taken with it, if wanted, but nothing fluid). If larger quantities of porridge are given one may very well obtain pictures of the stomach wall, but the shadow will be rather indistinct, partly because the opaque layer will be very thin, and partly because the folds of the mucous membrane will be obliterated.

With this technique, however, it happens not infrequently that

one fails to obtain pictures of the interior of the stomach. I suppose the underlying cause is most frequently that one waits too long in administering the second mouthful of food so that the first mouthful travels down by its own weight as far as to the bottom of the cavity. It may also be that some fluid is already present in the cavity of the organ. The previous contents will then act as a »first mouthful», and the barium meal will fall through to the bottom of the cavity. In the latter case, the difficulties might be overcome by evacuating the gastric contents by suction.

In case the later administered, transparent substance is of a too thin consistence, no picture of the wall will appear, presumably because the porridge will then wash off the first ingested opaque mouthful from the gastric wall. (Further mention will later be made of the fact that the gastric contents are normally of a more fluid consistence than is usually imagined).

In collaboration with Mr. Marcussen, the pharmaceutical chemist, who has recently died and to whom I am greatly indebted for his valuable assistance, I have undertaken a long series of investigations in order to find out which substance would prove most valuable in making the opaque meal adhere to the stomach wall. (Bismuth carbonate seemed to be too heavy, as it would form a sediment too quickly). Mucilage of quince-seed and tragacanth, mucilage of linseed and gum arabic did not seem to increase the tendency of the barium pap to adhere to the stomach wall. Nor did oat-meal gruel or wheat-flour pap prove to be of any value. The best pictures were obtained, as has been mentioned, by employing a thick porridge of rice-meal, both as a vehicle for the barium and as a transparent filling material.

Against the objection that the pictures obtained will not represent the inner surface of the stomach but a mixture of pap and barium sulphate inside the cavity, the following points may be advanced:

1) the pictures show a reticular and tortuous formation, very similar to the folds and wrinkles known from pictures of the inside of the stomach;

2) if there be a large fold in the fundus this will be especially distinct;

3) the technique of the method is based on physiological facts;

4) the same picture which, for instance appears, after the patient has ingested 200 grams barium meal, will reappear or, rather, be recognized, when the patient has eaten 400 grams of the meal;

5) the movements taking place in the stomach of the mouthfuls ingested later, as will be mentioned further on.

The region of the greater curvature appears usually most distinctly in the pictures (Fig. 4, 5, 6), (compare, on the other hand, the picture of the wall in the case of gastric ulcer, Fig. 13); — the assertion that there are fewer folds, has, as far as I know, not been proved. Whereas the region close to the lesser curvature *may* be entirely devoided of folds and this tends to explain why the shadows give a less distinct picture in these parts. Again, it may be conceived that the later ingested food, during its downward passage through the cavity, carries along with it some of the barium deposited in the neighbourhood of the lesser curvature, more especially in cases of stomachs of the Rieder type.

A roentgenogram of the stomach, obtained by this method, seems as a rule not to lend itself to the study of the conditions of the pyloric part.

Sometimes the entire first mouthful will remain adherent in the fundus of the stomach (Fig. 6); sometimes the whole aspect of the wall will appear as a very indistinct shadow, because nearly all of the barium meal will accumulate at the bottom of the cavity. (Fig. 7.) In other cases, again, some of the barium meal will fall to the bottom, while the major portion will settle on the walls of the organ

Lateral roentgenograms of a stomach filled in the manner described above show that both the anterior and the posterior walls of the organ are represented in the picture; the barium is, thus, not deposited only on the posterior wall. Stereoscopic roentgenograms are therefore to be preferred in the study of this kind.

The exposure should be as short as possible because of the movements of the mucous membrane (FORSSELL) and the whole muscular system of the stomach.

In roentgenograms made in the manner described above the normal inner surface of the stomach appears irregular and reticulated (Fig. 2 & 5), or as composed of tortuos lines, frequently *parallel with the greater and lesser curvatures* (Fig. 3 & 4 etc.) The name of WALDEYER has, as is well known, been associated with the "Magenstrasse" which, in his opinion, is formed in certain cases by folds of the mucous membrane running parallel with and close to the lesser curvature. Numerous investigators have agreed in this. My roentgenograms also indicate that the folds of the mucous membrane in the region of the lesser curvature *usually* are parallel with the latter, and, *moreover, that the folds of the stomach right up to the greater curvature very frequently are parallel with the curvatures.* The folds which in an excised stomach are seen to have quite an irregular course might therefore

Fig. 1.

Fig. 2.

Fig. 3.

Fig. 4.

Fig. 5.

Fig. 6.

Fig. 7.

Fig. 8.

be supposed frequently to assume a *mainly longitudinal course in the upright position of the body when the organ is filled with food.*

Here and there in roentgenograms of stomach walls we find some patches which may perhaps be ascribed to anatomical formations, perhaps to clumps in the barium meal, or perhaps to a coinciding of the shadows of the anterior and posterior walls.

In the ordinary pictures of the stomach, obtained by RIEDER's method, signs of a transverse fold or pouch in the fundus of the stomach are frequently seen. (Fig. 5, 6, 7, 8.) This is usually conceived as being due to pressure of the transverse colon. It may show all stages of transition, from a pouchlike to diverticulum-like formation. (Diverticuli of the stomach fundus are no rare occurrences: BORGBJAERG & FISCHER demonstrated such cases before the Association for Internal Medicine in Copenhagen a few years ago, and ÅKERLUND reported some cases at the Third Congress of the Northern Association for Medical Radiologi, Stockholm, June 1923). The said transvers fold or pouch in the fundus of the stomach has, however, somehow escaped due attention. Among other things, this may be ascribed to the fact that this transverse fold is not very conspicuous in roentgenograms taken after the usual Rieder test meal, because it does not always manifest itself by irregularities in the contours of the silhouette of the stomach. In roentgenograms produced after my method, however, this fold is seen very distinctly, and one is astonished at the frequency and variation of these formations which have hitherto usually been quite overlooked. The pictures I have taken of stomachs, in the fundus of which folds or pouches appear, do not as a rule seem to indicate that pressure of the colon is the cause of the phenomenon (Fig. 5, 6, 7). However, I will not enter further into this question at present, but confine myself to state that such a fold may be found in stomachs that are apparently quite normal.

One of the advantages of the method described is that the pictures represent stomachs during their normal function. Furthermore, the movements of the food swallowed later in the meal can be studied on its way through the cavity. The method is easy to employ, does not involve any danger and causes the patients very little inconvenience.

Its disadvantages are that some investigations fail because the barium meal does not always remain adherent to the gastric walls: and the condition of the shadows will sometimes be rather vague, which diminishes the value of the method in cases of very big persons.

The method seems most valuable for the studying of the fundus — the pyloric part seems rather inaccessible for investigations of this kind. The picture of the stomach walls will persist only for a short period — however, in a case of gastric cancer, I have seen the same picture persist for about one quarter of an hour (Fig. 15).

II. Studies on the Deposition of the Food in the Stomach, More Especially the Relations of the So-Called "Sulcus Salivalis"

In the muscular system of the stomach which, as is well known, consists of three coats, there is a muscular bundle in the inner coat called the oblique fibres. These muscular fibres run between the oesophagus and the wall of the fundus (the "horse-shoe bundle" of Kaufmann), riding on the incisura cardiaca and then running parallel with the lesser curvature at a small distance from the right border of the organ spreading fibres across the body of the stomach. In some species of animals, in the kangaroo for instance, this muscular bundle appears almost like the taeniae of the colon. In the dog, as in many other animals, this bundle may produce quite a canaliform contraction of the stomach along the lesser curvature (KAUFMANN, BAUER). That similar conditions do exist in man is an old supposition, first advanced by RETZIUS. In 1863, LUSCHKA expresses his agreement with this theory. In 1904, HASE & STRECKER give a detailed description of this furrow which they call "sulcus salivalis sive gastricus", and which they conceive as forming itself *passively* between the aorta and the Spigelian lobe of the liver. STRECKER writes, on a later occasion, that the oblique fibres are able by *active* contraction to form this furrow which might then be supposed to assume more and more a definite shape the more the stomach is becoming filled. Thus, in a filled stomach such a "canalis salivalis" would exist, extending from cardia down towards the pylorus. KAUFMANN and others are also in agreement with this theory which had even been advanced before by KÜSS & DUVAL.

The existence of this sulcus or canalis salivalis has never been confirmed by operation or by post-mortem examination. (In Hiss' picture of an opened human stomach from a "hardened" corpse there is no sign of such a furrow in the region of the lesser curvature.) Several authors disagree with this theory of STRECKER: KAESTLE, DIETLEN and FORSSELL, thus, point out that this "sulcus" or "canalis" does not appear in roentgenograms.

Further, it must be observed that several authors confuse this "sulcus salivalis" with WALDEYER's "Magenstrasse", which, as has been mentioned above, is a passage in the region of the lesser curvature, a passage which has got its special character by *folds of the mucous membrane* running longitudinaly. (It may be noted in this connection, that FORSSELL is of the opinion that the "Magenstrasse" is characterised more by a free lumen persisting close to the lesser curvature owing to the absence of transversal folds than by the formation of a furrow between longitudinal folds. In a comprehensive treatise published in 1923 BAUER expresses his full agreement with WALDEYER's view.)

Anatomically, we should thus distinguish between a (possible) *furrow or canal formed by muscular contraction*, and a "Magenstrasse" *formed by folds of the mucous membrane*, or at any rate, by the mucous membrane itself, both situated in the region of the lesser curvature.

Animal physiology teaches us that water may pass through the stomach at such a rapid rate that it will not even become sour. OTTO has found that isotonic solutions of magnesium sulphate will travel very rapidly through the stomach, but that the passage both of hypertonic and hypotonic solutions is slower. J. MÜLLER has demonstrated that liquids of body temperature run more rapidly through the stomach than liquids which have either a higher or lower temperature. Moreover, it has been proved that mineral water, milk, beer, etc., run through the stomach at a rather slow rate; briefly speaking it is, thus, not the degree of fluidity alone, but also the chemical conditions that decide the duration of the fluid retention in the stomach. Many physiologists teach that also in human beings does water run through the canal of Strecker from the cardia to the pylorus, thus passing the other contents in a filled stomach. (That a clean groove, free from any other contents of food and thus adapted for fluid alone, may be formed in an otherwise filled stomach, seems to me quite incomprehensible.)

The problems concerning the anatomical conditions of the region of the lesser curvature, and more especially the physiological ones, are of the very greatest interest. I will only remind my readers that almost all ulcers in the descending part of the stomach are located in the region of the lesser curvature. BAUER even sets up as a dogma that all typical "ulcera rotunda" are localized to the "Magenstrasse", and a number of other authors (KRATEISEN, GROSS, WESTPHAL, SMIEDEN, ORAT (300 cases), and many others) agree with his view on this matter. ASCHOFF advances the theory that gastric ulcer is due to lesions caused by the mass of food gliding along the lesser curvature; STROHMEYER has further elaborated this theory.

Any operation for gastric ulcer, any resection of the stomach might be thought to cause a severe functinal disturbance of the organ in case a "canalis salivalis" is present and has an important function to perform in the human stomach (quite apart from all other risks involved by the operation).

If, from a roentgenologic point of view, one wishes to take up a standpoint with regard to these problems, the following considerations would present themselves; as has been said, FORSSELL, among others, has called attention to the fact that "sulcus salivalis" is not seen in roentgenograms. A formation which, somehow, might be comparable with "sulcus salivalis" is the "isthmus" hour-glass stomachs; the "isthmus" formation is, however, due to contraction of bundles of circular muscles, while "sulcus salivalis" is thought to be due to muscular bundles having a parallel longitudinal course.

The first mouthful of an opaque meal is seen to settle as a triangular mass just below the air space in the stomach. This does not seem to indicate any narrow passage in the region of the lesser curvature. On the second mouthful being ingested, the barium meal is seen to run down in a thin stream, undoubtedly in the region of the lesser curvature. So far one must therefore agree with the theory of a "Magenstrasse", and with FORSSELL's view that the filling of the cavity takes place with this furrow as a starting-point.

In order to find out what happens later on during the filling up of the stomach, I have carried out the following experiments:

1) The person to be radiographed was given an ordinary RIEDER meal. Having ascertained that there was no "intermediary layer", I gave him a glass of water to drink. *This settled above the barium meal.*

2) I took some roentgenograms of the gastric walls by means of the technique described above. When the stomach was nearly filled, the person in question got a tablespoonful of barium water of a milky consistence (barium sulphate is heavy but chemically quite indifferent — cf. OTTO's experiments). On the fluorescent screen I saw the water enter at the cardia, and *then follow the lesser curvature, that is to say, as long as the latter had a vertical position. When this was no longer the case, the barium water left the lesser curvature and followed a vertical course to the bottom of the cavity.* The same experiment was carried out on some persons who were bending to the left: Again, *the barium water followed the vertical course, leaving the lesser curvature at a point less distant from the cardia* than in the previous experiment (Fig. 8).

In stomachs having a transverse position, the barium water was seen to leave the lesser curvature at the level of the cardia and to follow a vertical course to the greater curvature. (Fig. 9.)

Fig. 9.

Fig. 10.

Fig. 11.

In one single case did the barium water take a winding course to the bottom of the cavity (Fig. 10); in another case it spread out and divided into two currents.

In lateral roentgenograms *the barium water seemed to pass along the posterior wall of the stomach.*

Thus, it can be proved that *in none of my experiments did the water follow any "sulcus salivalis" along the lesser curvature; when the water was lighter than the food previously ingested, it would settle above it, when it was heavier, it would follow a vertical course and glide along the posterior gastric wall.*

The somewhat irregular, winding course and the division of the current seen in the two cases, might be accounted for as being due to the folds of the mucous membrane of the posterior wall of the cavity, and perhaps to some peristaltic influence.

In none of my pictures did I see any sign of a "sulcus salivalis", neither in the form of deposits of barium meal on the wall, nor in any other form. On one occasion I made a man eat a mouthful of barium meal, having first taken a roentgenogram of his stomach walls. The meal was seen to glide vertically downward from the cardia as a fine continous shadow, not the least indentation of the edges of a "sulcus salivalis" being detectable. (Fig. 11.) All my experiments, *speak, thus, against the presence of a "sulcus salivalis" in man,* in the form described by RETZIUS, KAUFFMANN, STRECKER, and others.

During my experiments I made a rather curious observation: on pouring barium water into a bowl of barium-free pap of the consistence I usually employed for after-filling, the barium water would fall into the pap very slowly, whilst in the stomach it would take a very rapid declivous course. Even a thick barium meal would fall very rapidly through the contents of the cavity. This can hardly be due alone to the fact that the folds of the mucous membrane are chiefly longitudinal at the posterior gastric wall — when the person stands erect and the stomach is filled. Nor can it be supposed that the mixing with saliva, mucus from the oesophagus, and gastric juice, which takes place, would be sufficient to dilute the contents of the stomach to the degree mentioned. It seems to me more reasonable to look for the causative factor of this rapid declivous course of the barium water meal *in the ptyalin digestion, which might have made the concistence of the gastric contents very thin* — as this form of digestion is said to take place at a fantastically rapid rate — this, of course, in conjunction with the two other factors mentioned.

Wishing to compare my observations with those previously published I find it practical to divide the latter ones into two groups:

1) *Experiments on animals* (COHNHEIM, OTTO, and others). The differences between the anatomical conditions in animals and those in man, and the upright position of man, will explain the divergence between the observations made. In animals, in their normal position, when their stomach is filled, the lesser curvature, being that part of the organ which is most fixed, will lie at a higher level, while the greater curvature will be lower. Thus, without violating the law of gravity (and even without the presence of a "canalis salivalis") a fluid will be able to run along the lesser curvature across the more heavy contents of the stomach to the duodenum. Moreover, as has been mentioned before, in many animals there is a true "canalis salivalis".

2. *Theories and observations made in regard to man.* We have already contradicted the views first advanced by RETZIUS, and later on elaborated by STRECKER; concerning the presence of a sulcus salivalis in man, ERNST's observations of corrosions in the region of the lesser curvature when only a slight quantity of a corrosive substance has entered the stomach, do not, in my opinion, speak against my own observations. Poisoning is itself such a violent trauma that it may very well be able to induce the most varying forms of contractions in the stomach. And, moreover, it is not at all surprising that a fluid will glide some distance along the lesser curvature in the event of the stomach being empty.

The prevailing views of to-day concerning the laws governing the filling of the stomach (BAUER 1923) are nearly all based on FR. GROEDEL's extensive work of 1912, "Die Magenbewegungen", in which the author, on the basis of extensive Roentgen investigations, attempts to make these matters clear. GROEDEL's experiments are all excellent and seem, on the whole, to fit in very well with my own observations and theories; hovewer, the conclusions at which GROEDEL himself arrives seem to me to be erroneous in many cases, as they are neither in keeping with the results of his experiments nor with my own observations.

He states that barium water swallowed after the stomach has been filled, will *first proceed along the lesser curvature, then "envelop" the contents of the cavity as far as the greater curvature, to reach the pylorus eventually by travelling along this curvature.* In his Case No. 9, bismuth water can even be seen "to flow around" the entire contents of the stomach. According to my observations, however, *any fluid that is heavier than the food previously ingested will take a declivous course along the posterior wall of the stomach* (in the erect

position), *following the lesser curvature only as long as the latter has a vertical direction.* That bismuth water would behave in a different manner to barium water, is, I think very improbable. I think the divergency of the results obtained in GROEDEL's and in my own observations may be ascribed to the fact that GROEDEL employs 250 gm. of water and 50 gm. of bismuth carbonate, while I use 15 gm. of water and some few gm. of barium sulphate. GROEDEL's illustrations, Nos. 46—47—48, do not, as far as I can judge, appear to tally with his own view, as the barium shadow is extremely broad from the cardia to the bottom of the stomach. In this shadow there are some defects. I think that these pictures are better in agreement with my view — that the large quantity of fluid will tend to spread behind the other contents of the stomach. Some few folds of mucous membrane rise like islands out of the fluid. The fluid glides in a declivous current along the posterior wall and in larger quantities along the lesser curvature. On another occasion GROEDEL says that fairly large quantities of liquids of a thin consistence and also gastric secretions will tend to ascend. (SCHLESINGER's intermediary layers.) Thus, GROEDEL lays down two diametrically opposed laws for the behaviour of fluids in the stomach, without seemingly going further into the cause underlying this paradoxical result of his investigations.

His views have, however, been collected in a summary which has been quoted by himself and by other writers on various occasions, but they do not correspond very well with my findings. I will, therefore, go a little further into some of the main points of this summary.

"*Whether the stomach be filled or empty, solid or fluid food will always enter it in the form of a wedge*". (Neither GROEDEL's illustrations, Figs. 26—29, nor my own pictures of barium water or barium meal ingested on a filled stomach, Figs. 8—11 etc., show any wedge formations.) "*Solid and liquid food will travel downward along the "gastric furrow" in the lesser curvature*". (This is not correct in the case of light fluids, when the contents already present in the cavity have a higher specific gravity; nor does it obtain for stomachs in a transverse position in the event of the specific gravity of the last ingested food being higher than that of the food previously ingested. In stomachs of the RIEDER type this assertion will only obtain in so far that the lesser curvature has a vertical direction and the food last partaken of is heavier than that first ingested. Finally, the assertion holds good only when it is a question of small quantities of food. GROEDEL (Figs. 46—48). "*As long as the stomach is not completely dilated, and pars descendens has thus not been quite filled, these wedges of food will quite simply settle one upon the other, only forcing*

themselves slightly into one another, so as to produce a picture of funnels pushed into one another". (This does not hold good if the contents of the stomach do not have the same specific gravity, and, moreover, had this law been absolutely valid, I should not have been able to produce my pictures of the gastric walls.) "*When the dilatation in the vertical direction has been completed, the proper filling up of the stomach commences; in this process the succeeding portions of food will pass the food previously ingested, availing themselves of 'die Magenstrasse'.*" (I can agree with the first part of this assertion; as for the latter part, GROEDEL bases his conclusion on some investigations which, in my opinion, he misunderstands, as he seems to pay no heed to the difference between the specific gravity of *bismuth meal* and *bismuthfree meal*. First he gave some bismuth pap, then pap without bismuth, and then again bismuth pap to person with a stomach of the RIEDER type. The last ingested bismuth pap was now seen to glide through (or behind) the bismuth-free portion lying nearer the lesser curvature — forming, however, so wide a shadow that there could hardly be any question of a "Magenstrasse" according to WALDEYER's conception of the term. On the basis of such experiments GROEDEL makes the above-mentioned, as well as the following, assertions. The last quoted sentence of GROEDEL is, however, also contradicted by my afore-mentioned views. GROEDEL confuses "sulcus salivalis" with WALDEYER's "Magenstrasse", pag. 19.) A little further on GROEDEL states: "*In consequence of this, there now occurs a partial retrograde movement of the chyme towards the greater curvature*". (Whether the last ingested food will glide nearer the greater or the lesser curvature depends upon the form of the stomach, its more or less vertical position, and the relative specific gravity of the food, as has been proved in the preceding pages (cf. for instance Fig. 9.) Moreover, GROEDEL affirms: "*According to my observation, the consistence of the food does not seem to play any important part in regard to the process of stratification of the food during the ingestion.*" (In my own opinion, however, the consistence of the food is of some importance, in that substances of a *thin* consistence will mix more readily with one another than those of a less fluid consistence. Thus, I failed in obtaining pictures of the stomach wall when, for the purpose of filling the stomach, I used liquids of a thinner consistence such as oat-meal gruel; in that case, it seems that the opaque first mouthful is washed down by the succeeding mouthfuls. Moreover, the gastric contents usually seem, as has also been mentioned above, to be of a rather fluid consistence.)

GROEDEL summarizes his views in the following statement: "*The difference in the behaviour of the food successively ingested — whether*

the stomach be filled with solid or fluid contents — shows us that the filled stomach always attempts immediately to bring freshly supplied food close to the pylorus". As, in my opinion, the foundations upon which this assertion has been built up will not stand a close investigation, one must be warranted in declaring that the assertion has not been proved — according to GROEDEL's own statement it is even directly erroneous so far as light fluids are concerned.

That GROEDEL has thus pronounced laws which are not correct, is due partly to the fact that his technique is imperfect, and partly to his making erroneous conclusions. Evidently he has worked with stomachs of the RIEDER type only and not with any of the HOLTZKNECHT type, which are, however, just as normal. He does not seem to have examined his subjects of experiment in the lateral position, nor to have attempted to make the vertical line fall outside the lesser curvature by inclining the person towards the left. Moreover, he employed large portions of bismuth meal and bismuth water, where small portions would have furnished much better information. Evidently he has been prejudiced by his conception of the importance of "sulcus salivalis", and thus he does not seem to have sufficiently realized the fact that the lesser curvature and the vertical line coincide for a rather long distance in stomachs of the RIEDER type. Above all, however, he has overlooked the great importance of the specific gravity of the gastric contents. In his "Røntgendiagnostik", 1914, pag. 319—320, he deals with the question whether the additional weight of 50 gm. of bismuth carbonate may be thought to exert any influence on the gastric contents, and he arrives at the conclusion that 50 gm. of bismuth can have no influence whatever when mixed with 350 gm. of pap. This view would perhaps be correct, if it were not that the gastric contents quickly assume a fluid condition, so that even slight variations in the specific gravity will influence the relative deposition of the food elements in the stomach.

The reason why I have entered so fully into GROEDEL's work is, as I have said, that his views of these matters have been accepted by many writers up to the present day. Some few investigators, however, disagree with him. SCHLESINGER, among others, thinks that, owing to the "intermediary layer", other factors than "Magenstrasse" and "sulcus salivalis" must be considered decisive for the movements of the food in the stomach. KATSCH & v. FRIEDRICH, and ELZE find it more probable that the food follows the "Führungslinie" of the stomach (an imaginary line from the centre of the cardiac orifice to the centre of the pyloric orifice through the stomach cavity, drawn so that it passes through the centre of any transverse section of the stomach). WESTPHAL, too, seems to incline towards this view. ASSMANN refers

to the prevailing views of the function of a "sulcus salivalis" and a "Magenstrasse", but is a little sceptical owing to the "intermediary layer".

In the Roentgen investigations which have hitherto been undertaken in order to examine the conditions of the food in the stomach, no care has been exercised in choosing food-stuffs of exactly identical specific gravity (which would perhaps also involve great difficulties); *these roentgenological studies of the relative movements of the food-stuffs in the stomach are therefore of but slight value*, as they do not furnish any important information with regard to these matters under normal conditions, when the various food-stuffs have identical specific gravity.

The factors which, in my opinion, should come into consideration concerning the filling up of the stomach in man in the erect posture are therefore the following:

1) the law that "the heavier substances will take the more declivous course",

2) the law "that the food last ingested will endeavour to get inside of the food previously ingested",

3) the consistence of the gastric contents,

4) the anatomical structure of the stomach and the movements of the folds of the mucous membrane, etc.,

5) peristole, peristalsis, abdominal pressure and pressure from adjacent organs,

6) the chemical laws (OTTO), of which we are quite ignorant as far as the human stomach is concerned. — In this point, too, the roentgenologist may perhaps be of some help to the physiologist,

7) the physical laws concerning diffusion, friction, etc. (the law that adhesion is stronger than cohesion may perhaps be of some importance as far as the first mouthful is concerned.)

III. The Value of the Method Described for Detecting Pathological Conditions of the Stomach.

It is difficult at present to say anything definite as to the value of method 2 in the future study of pathological conditions of the stomach. The cases I have hitherto examined by this method are only few in number. And in none of these cases has an operation or autopsy been performed to verify the results.

Fig. 12.

Fig. 13.

Fig. 14.

Fig. 15.

On some occasions, however, I think that my pictures of the gastric wall have afforded a valuable supplement to the usual Roentgen examination.

Thus, an extremely irregular appearance of a greater curvature made me doubt whether the irregularity was due to normal folds of the mucous membrane, or, perhaps, to a tumour. A picture of the gastric wall showed — according to my judgment — that the conditions were normal.

In a case of resection of the stomach I observed in a picture of the gastric wall some fine lines issuing from a certain point in the contour of the stomach; I interpreted them as being due to a suture having produced wrinkles in the mucous membrane.

The following two cases are perhaps of greater interest; the first one is a gastric ulcer, the second, a gastric cancer.

1) The patient, an elderly woman, had suffered from haematemesis, the first time in 1888 — it was, thus, a question of a very old gastric ulcer. The roentgenogram showed a spastic hour-glass stomach of the usual appearance, but without a distinct niche in the region of the lesser curvature. A lengthy, smooth prominence is seen to project from the lesser curvature a little nearer the cardia than the spasm. The shadow of this prominence appears less intense than the other parts of the stomach. (Fig. 12.) In the picture of the gastric wall obtained by my method a patch which is due to an accumulation of the barium meal is seen in the region of *the lesser curvature*, corresponding to the smooth prominence seen in the first picture. As has been pointed out on several occasions in the previous pages, the barium meal shows a tendency to settle chiefly on the greater curvature in pictures of the gastric walls. Therefore, I *suppose* that the patch may be ascribed to an accumulation of barium meal in an ulcer cicatrix or in an ulcer of a rather considerable extension. (Fig. 13.)

2) In a picture of the stomach, taken after RIEDER'S method, some indentations are seen in the region of the body of the stomach — two at the greater and one at the lesser curvature. These indentations can hardly have been caused by anything else but tumours. (Fig. 14.) In a picture of the gastric wall, taken after my method, some easily recognisable structures are seen, but the tumours appear much larger and are seen to be situated in three rows across the stomach. Unfortunately, I omitted to take a lateral picture. In this case there can be no doubt as to the value of the picture of the gastric wall. The appearance of this picture was not a mere chance; this became evident by a new picture which was taken a quarter

of an hour after the meal, and which proved to be almost exactly identical with the first one. (Fig. 15.)

SUMMARY. *A.* Two new methods for rendering the inner surface of the stomach visible in a roentgenogram are described:

1) by *covering the walls with dry bismuth powder while the cavity of the stomach is filled with air.* This method has, however, not been fully worked out owing to its being rather troublesome and not answering all the requirements one might make upon pictures of the gastric inside. The method is illustrated by a picture of a stomach showing a cicatrice in the region of the *greater* curvature. The rare occurrence of ulcer of the greater curvature is briefly mentioned.

2) by *covering the gastric walls with a layer of barium meal, while the other parts of the cavity are filled with a substance that does not produce any shadow in the picture.* (First half a table-spoonful of concentrated barium meal and then 200 à 300 gm. of rice-flour pap.)

B. Method 2 employed for physiological studies:

1) A "sulcus salivalis" in the sense of a furrow or canal, through which water may pass other gastric contents, does not exist in man in the erect posture, at any rate not when the gastric contents have different specific gravities.

2) It can be demonstrated (by means of method 2) that the folds of the mucous membrane in man in the erect posture will often have a longitudinal direction as far as to the greater curvature.

3) A transverse fold or pouch in the fundus of the stomach, which frequently appears very distinctly in the pictures of the inner surface of the stomach, is mentioned. It is hardly due to pressure from the colon.

4) The prevailing views regarding the movements of the food after its entrance into the stomach — perhaps most distinctly defined by GROEDEL in his "Die Magenbewegungen" — are erroneous in numerous points.

5) The specific gravity of the food-stuffs must be considered a factor of the very greatest significance for their relative distribution in the stomach. This fact does not seem to have been emphasized with sufficient clearness in earlier papers.

C. Method 2 seems to be of value for the detection of pathological conditions in the stomach. This is illustrated by two examples.

1) one of gastric ulcus.

2) one of gastric cancer.

ZUSAMMENFASSUNG. A. Beschreibung zweier neuer Methoden zur Sichtbarmachung der Magenwände in einem Röntgenogramm:

1) durch *Bedeckung der Wände mit trockenem Wismutpulver, während die Magenhöhle mit Luft gefüllt ist.* Diese Methode wurde indes nicht völlig ausgearbeitet, da sie ziemlich viele Schwierigkeiten bietet und nicht allen Anforderungen entspricht, die man an Bilder der Magenwände stellen möchte. Die Methode ist durch das Bild eines Magens illustriert, der eine Narbe in der Region der *grossen* Kurvator zeigt. Das seltene Vorkommen einen Ulkus an der grossen Kurvator ist kurz erwähnt.

2) durch *Bedeckung der Magenwände mit einer Schichte von Bariumbrei, während die übrige Höhle mit einer Substanz gefüllt wird, die im Bilde keinen*

Schatten hervorruft. (Erst ein halber Esslöffel konzentrierter Bariumbrei und dann 200—300 g dicken Reismehlbrei.)

B. Methode 2 zu physiologischen Untersuchungen verwendet:

1) Ein »Sulcus salivalis» in der Bedeutung eines Kanals oder einer Furche, durch welche Wasser an dem anderen Mageninhalt vorbeipassieren könnte, exstiert bieim Menschen in aufrechter Stellung nicht, jedenfalls nicht, wenn die Kontenta des Magens verschiedenes spezifisches Gewicht haben.

2) Es lässt sich (mit Hilfe von Methode 2) zeigen, dass die Schleimhautfalten beim Menschen in aufrechter Stellung oft bis zur Curvatura major eine longitudinale Richtung haben.

3) Verf. weist auf eine Querfalte im Magenfundus hin, die in den Bildern der Magenwände häufig sehr deutlich erscheint. Sie ist schwerlich auf Druck vom Kolon zurückzuführen.

4) Die herrschenden Anschauungen betreffs der Fortschaffung der Nahrung nach ihrem Eintritt in den Magen — wie sie am deutlichsten vielleicht in *Groedels* »Die Magenbewegungen» zum Ausdruck kommen — sind in vielen Punkten irrig.

5) Das spezifische Gewicht der Nahrungsstoffe muss man als einen Faktor von der allergrössten Bedeutung für ihre gegenseitige Verteilung im Magen betrachten. Diese Tatsache scheint in früheren Arbeiten nicht mit genügender Klarheit betont zu sein.

C. Methode 2 dürfte für die Aufdeckung pathologischer Zustände in Magen von Wert sein. Dies wird durch zwei Beispiele illustriert.

1) einen Fall von Magengeschwür und

2) einen Fall von Magenkrebs.

RÉSUMÉ. *A.* Deux nouvelles méthodes de rendre la surface intérieure de l'estomac visible par la radiographie sont déterminées:

1) de couvrir la paroi de poudre de bismuth sèche, tandis que la cavité de l'estomac est remplie d'air. Cette méthode n'a cependant pas été tout a fait perfectionnée. Cela dépend de ce qu'elle est plutôt douloureuse et qu'elle ne répond pas à toutes les exigences que l'on peut avoir d'images des viscères gastriques. La méthode est illustrée par une image d'un estomac, montrant une cicatrice dans la région de la *grande* courbure. La rare présence d'ulcère de la grande courbure est brièvement mentionnée.

2) de couvrir la paroi gastrique d'une couche de farine de baryum, tandis que les autres parties de la cavité sont remplies d'une substance qui ne produit pas d'ombre sur l'image. (D'abord une demie cuillerée de farine de baryum concentrée et puis 200 à 300 gr. de pâte de farine de riz.)

B. La méthode 2, employée dans des études physiologiques:

1) Un »sulcus salivalis» dans le sens d'un sillon ou d'un canal, par lequel l'eau peut dépasser d'autres contenus gastriques, n'existe pas dans l'homme quand il se tient debout, en tout cas pas quand les contenus gastriques sont de poids spécifique différent.

2) On peut démontrer (par la méthode 2) que les replis de la membrane muqueuse dans l'homme, quand il se tient debout, souvent ont une direction longuitudinale jusqu'à la grande courbure.

3) Un pli transversal ou une poche dans le fond de l'estomac est mentionné, qui se présente fréquemment très nettement sur les images de la surface intérieure de l'estomac. Il n'est guère causé par pression du côlon.

4) Les opinions générales concernant les mouvements de la nourriture

après son entrée dans l'estomac — peut-être le plus nettement définies par Groedel dans son »Die Magenbewegungen» — sont en plusieurs points inexactes.

5) Le poids spécifique des ingrédients de la nourriture doit être considéré comme un facteur de la plus grande importance pour leur distribution relative dans l'estomac. Ce fait ne paraît pas avoir été relevé assez nettement dans des ouvrages antérieurs.

C. La méthode 2 paraît être de grande valeur quand il s'agit de découvrir des conditions patologiques dans l'estomac. Ceci est illustré par deux exemples:

1) un cas d'ulcère gastrique.
2) un cas de cancer gastrique.

RESUMEN. *A.* Se indican dos nuevos procedimientos para hacer visible por la radiografía las paredes internas del estómago.

1) Cubrir la pared interna con polvo de bismuto seco, al mismo tiempo que la cavidad estomacal se llena de aire. Este método todavía no ha sido completamente perfeccionado. Esto depende de que el mismo es algo molesto y doloroso y que no responde a todas las exigencias para obtener imágenes de las vísceras gástricas. El método va ilustrado con una imagen de un estómago, mostrando una cicatriz, en la región de la *gran* curvatura. Se menciona brevemente la rara presencia de úlcera en la gran curvatura.

2) Cubrir la pared gástrica de una capa de polvo de bario, mientras que las otras partes de la cavidad se llenan de una substancia que no produce sombra sobre la imagen. (Al principio media cucharada de polvo de bario concentrado y después 200 a 300 gramos de una pasta de harina de arroz).

B. El método 2 empleado en los estudios fisiológicos:

1) Un »sulcus salivalis» en la dirección de una grieta o de un canal, por el cual el agua puede traspasar los otros contenidos gástricos, no se encuentra en el hombre cuando se halla en posición vertical, en todo caso tampoco cuando los contenidos gástricos son de peso específico diferente.

2) Se puede demostrar (por el método 2) que los pliegues de la membrana mucosa en el hombre, cuando se halla en pié, tienen a menudo una dirección longitudinal hasta la gran curvatura.

3) Un pliegue transversal o una bolsa en el fondo del estómago, se menciona, que se presenta frecuentemente muy límpida en las imágenes de la superficie interior del estómago. Se debe grandemente a la presión del colon.

4) Las opiniones generales concernientes a los movimientos de los alimentos después de su entrada en el estómago, — tal vez lo más netamente definidas por Groedel en su »Die Magenbewegungen» — son en muchos puntos inexactas.

5) El peso específico de los componentes de los alimentos debe considerarse como un factor de la mayor importancia para su distribución relativa en del estómago. Este hecho no parece haber sido considerado con bastante claridad en las obras anteriores.

C. El método 2 parece ser de gran valor cuando se trata de descubrir condiciones patológicas en el estómago. Este caso va ilustrado por dos ejemplos:

1) un caso de úlcera gástrica.
2) un caso de cancer gástrico.

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PROCEEDINGS

OF THE

NORDISK FÖRENING FÖR MEDICINSK RADIOLOGI

AN ACCOUNT OF THE THIRD MEETING
OF THE SOCIETY,

STOCKHOLM,
JUNE 18 AND 19, 1923

EDITED BY
TEODOR LARSÉN, M. D.
SECRETARY

Minutes of the Third Ordinary Meeting of the Nordisk Förening för Medicinsk Radiologi;

Held at Svenska Läkaresällskapet, Stockholm, June 18th 1923, at 9 a. m.

§ 1. The President of the Association, Professor Gösta Forssell, declared the meeting open.

§ 2. The President spoke in commemoration of the late Honorary Members of the Association Professor W. C. von Röntgen and Professor J. Fr. Fischer, Copenhagen, and of the late member of the Association the Dr. Sev. Nordentoft, Aarhus.

§ 3. The Association elected Professor G. Forssell Chairman of the meeting. The following were elected Honorary Chairmen: Dr. A. Reyn, Copenhagen, Dr. G. A. Wetterstrand, Helsingfors, Dr. S. A. Heyerdahl, Christiania.

§ 4. The Association elected Dr. T. Larsén General Secretary of the meeting. To Assistant Secretaries were elected: for Sweden Dr. A. Åkerlund, for Denmark Dr. Chr. I. Baastrup, for Finland Dr. G. Jansson, for Norway Dr. A. Schiander.

§ 5. The Secretary read a report of the previous meeting in Copenhagen, Sept. 1921.

§ 6. The Association resolved that its next meeting should be held in Helsingfors in September 1925.

§ 7. The Association elected Dr. G. A. Wetterstrand, Helsingfors, its President for the ensuing period until the next meeting.

§ 8. The following were elected Members of the Board until the next meeting: for Denmark: Dr. H. J. Panner, Dr. A. Reyn and Dr. Chr. Baastrup (Deputy); for Finland: Dr. A. Boije, Dr. C. Gösta Jansson, Dr. G. A. Wetterstrand and Dr. A. Hornborg (Deputy); for Norway: Dr. E. Berle, Dr. S. A. Heyerdahl and Dr. H. Thue (Deputy); for Sweden: Dr. E. Berven, Prof. G. Forssell and Dr. L. Edling (Deputy).

§ 9. The Association resolved to set down the following subjects for discussion at its next meeting: 1) Light and Roentgen Therapy in Surgical tuberculosis, 2) Medical Radiology as a Branch of Medical Teaching.

Each country was to select introducers of the first subject, according to the decision of the local Committees.

Professor G. Forssell, Dr. S. Heyerdahl, and Dr. H. J. Panner were to introduce the second subject set down for discussion.

§ 10. At the proposal of the Board, Joseph Nachmanson Esq., Bank Director, Stockholm, and Dr. A. Soiland, Los Angeles, California, were elected Honorary Members of the Association.

§ 11. The Association decided to pass on to their scientific transactions.

Ad protocollum

T. Larsén

Gen. Secretary.

Scientific Transactions

I. The Meeting at Svenska Läkarsällskapet

on the 18th of June 1923 from 9.30 a. m. to 12 noon and from 1 to 4 p. m.

I. Chr. I. Baastrup, Copenhagen: The Acute Bone Atrophy and its Roentgen Picture[1]

The clinical picture which was first described by SUDECK as the »*acute trophoneurotic bone atrophy*» and then by KIENBÖCK as the »*acute bone atrophy*», and which is presented as a *contrast to the atrophy* by inactivity, is inaccurate and misleading — both from a theoretical point of view and with regard to the term employed.

1) The following considerations present themselves when the matter is looked at *from a theoretical point of view:*
   a) »Trophic» nerves are (hypothetical) *organs*, inactivity is a *cause of a pathological state. These two ideas can therefore not be placed in direct opposition to one another.* In contradistinction to a loss of bone by the way of »trophic» nerves one must set a loss of bone via other *organs.* Against loss by inactivity one must oppose a loss due to other *causes.* There is no ground for the supposition that inactivity exercises an influence through other organs than those by which the diseases and conditions that are pretended to be the cause of the »acute bone atrophy» are active.
   b) There seems to be *no reason to suppose that »trophic» nerves are of any importance* in the condition known as »acute bone atrophy».
   c) *The chief cause of the appearance of the »acute bone atrophy» is undoubtedly inactivity. Still, lesions of vessels and nerves — both of a toxic and of a traumatic kind — can probably be conducive to the development of loss of bone tissue.*
2) With regard to the term »acute bone atrophy» the following considerations are applicable:
   a) *The changes are not »acute»* according to the general definition of this word.
   b) The »acute bone atrophy» is a term formed as a parallel to the name of the simultaneously appearing changes in muscles — »muscle atrophy». But while »muscle atrophy» means *diminution of size*, »bone atrophy» is a *change in substance.*

The change in muscle corresponding to this change in substance is called »*muscle degeneration*» (fatty degeneration).

In order to get a distinct nomenclature the author therefore proposes

[1] Published in Acta Rad. vol. II fasc. 4—5 pag. 364

that »bone atrophy» should denote a *diminution in the size of the bones* (concentric atrophy), whereas *degenerative changes in the substance of the bones* (eccentric atrophy) should be called »bone degeneration» (or »lipomacie»). The term »rarefication» may be employed to express bone degeneration in a roentgenological meaning.

After having described the clinical picture the author enters upon a critical examination of the many diverging views regarding the development, causes and explanations of the disease. He considers himself justified — on the basis of his experiments on animals — to establish as a fact that a diminution of bones *always* takes place in connection with severe lesions of extremities, of whatever kind these may be, but that this diminution can not be recognized in the Roentgen picture when present only to a small extent. A rarefication of about 10 % is, as a rule, roentgenologically ascertainable in the bones of rabbits.

The spotted stage can probably only be observed in high degrees of rarefication. As a rule this stage appears fairly soon after the causal factor and disappears in the course of a few weeks or months, but the author has found it one year after the lesions had taken place.

The author's experiments on animals show *in a number of cases practically the same rapid origination and strong development of rarefication in connection with diverse lesions* as in *pure inactivity experiments* (plaster-bandaging) — all investigations have been carried out on the lower extremities of rabbits. *The bones in the affected extremity showed a constant decrease in strength.*

Rarefication from inactivity and from lesions gives exactly the same roentgenological picture.

The theories that have previously been advanced in the literature and which pretend to explain the nature of the »acute bone atrophy», are divided into 8 groups and critically examined. The author then expresses his own opinion which he bases partly on the literature, partly on his own observations and partly on his experiments on rabbits. And further it is founded on certain physiological observations and theories and culminates in the hypothesis that *local processes associated with the vessels and their nerves can explain the problems connected with this matter. It is further supposed that causes from the central nervous system or the sympathetic nervous system may be of some consequence.* This influence is thought to be bound with the *vasomotor nerves.*

Under the heading »diagnosis» the author emphasizes especially the relation between rarefication and tuberculosis.

The author is of the opinion that the rarefication may be of a considerable prognostic value and substantiates this view more closely.

Some prophylactic and therapeutic conclusions are drawn, the chief object of which is to urge to caution in reduction of fractures, to point out the necessity of sparing fractured bones as much as possible in operations, and to recommend the massage, active and passive exercises to be given as soon as possible during the clinical course. The main point is, however, to avoid immobilization of extremities as far as possible, or at all events to reduce the immobilization to the shortest possible duration and to the smallest possible degree.

Finally, the author sets forth in a short section some views regarding the importance of the rarefication for the insurance-question.

Discussion:

1. Gösta Forssell, Stockholm: I think we ought to be very much obliged to Dr. Baastrup for his exhaustive investigation concerning the so-called »acute bone atrophy». He has shown, in my opinion, in a convincing manner that this condition can be characterized neither as being in a strict sense *acute* nor as an *atrophy*. In place of the expression atrophy Dr. Baastrup wants to introduce the more adequate pathologic term »degeneration» and the term »rarefication» as denoting the changes appearing in the roentgenograms.

Dr. Baastrup has, however, not only revised our hitherto prevalent views about the »acute bone atrophy». He has also tried to advance some new definitions which better characterize the changes that have actually been proved. It seems to me quite appropriate to introduce, as proposed by Dr. Baastrup, the anatomo-pathologic term »*bone degeneration*» as denoting a decrease of the bone substance, analogous to the muscle degeneration. And the term »*rarefication*» as generally denoting the lime reduction seen in the roentgenograms is also, in my opinion, a very happy suggestion. But, on the other hand, I cannot agree with Dr. Baastrup when he advances the term »*lipomacie*» as equivalent to »bone degeneration» or »rarefication». It is true that by the investigations mentioned by Dr. Baastrup, as well as by other observations, it has been proved that the rarefication which is seen in the roentgenograms may in certain cases be caused by a »lipomacie» in association with an osteoclastic activity. But it has by no means been proved that this is the general rule. Thus, the author's own histological examinations of bones showing a highly reduced percentage of lime do not reveal any signs of lipomatosis, and I don't think one can very well speak of any other sure changes but just a reduction of the percentage of lime, a *halisteresis*. Anyhow, to me the idea does not seem altogether precluded that in certain *stages* or in certain *forms* of »bone degeneration» and »lipomacie» one has to reckon with the possibility of a decalcification of the bone substance, a halisteresis, without a breaking down of the bone substance.

And, further, it does not seem to me justifiable to regard the different kinds of bone degeneration, to the same extent as the author does, as being in their true nature a *degeneration by inactivity*. Even if we grant the author is right in his view that the rarefication cannot be explained by disorders of a bone-trophic nervous system, the existence of which is not proved, and even if we agree with him that a disorder of the circulation is probably the essential factor in the origination of the rarefication, yet it is a long stride from this to the supposition that inactivity is a general cause of the bone degeneration. A disorder of the bone nutrition may, however, be of an essentially different kind, and I can for my part quite imagine an essentially different process of decalcification in a circulatory disorder owing to a toxic oedema, to inactivity, to vascular spasm, or to a tearing of vessels. — As the author seems to compare the rarefication found in connection with a tumour of the bone with the degeneration by inactivity, I must also raise opposition. — In such a case it is probably essentially a question of a breaking down of the bone owing to the growth of the tumour.

Finally, I want to emphasize that the phenomena which are usually pointed to as »symptoms» of bone degeneration, such as *oedema*, *pains* and

muscle degeneration, are not of a certainty sequelae of the rarefication but are perhaps, on the contrary, in many cases the cause of it. I think it would be wise for the present to express a guarded opinion on the causality of the rarefication and the said »symptoms», and that it is necessary to await a far greater and more reliable knowledge before we can be quite sure about the true significance of the rarefication when estimating a bone lesion.

2. P. Flemming-Möller, Copenhagen: I do not think one is absolutely entitled to reject the term »halisteresis». What does Dr. Baastrup know about there being no loss of lime? What is it that makes the bones lighter after the atrophy?

On the whole, I do not think the atrophic conditions are quite so simple as Dr. Baastrup seems to believe, nor have I found anything in Dr. Baastrup's paper to convince me absolutely that the inactivity is the main cause of the atrophy. For instance, one can not get away from the facts of the case that Dr. Baastrup himself mentioned, in which the tibia was rarefied but not the fibula. Further I want to call attention to the fact that dysendocrinic disturbances are not unfrequently the cause of bone atrophy (I have observed myself several such cases where there can be absolutely no question of inactivity as a cause).

3. P. G. K. Bentzon, Copenhagen: I want to thank Dr. Baastrup as well as the Association for bringing up for discussion the question of acute bone atrophy. It is unfortunately a not unfrequent and dreaded complication in orthopedic operations. Especially after arthrodesis of the anklejoint in adults one finds that a very pronounced atrophy of the foot bones appears which is very awkward for the patient and causes intense pain when the foot is exposed to weight-bearing.

I have had an opportunity to make an observation that seems to me of some importance for this question. Some time ago a woman 28 years of age who showed symptoms of an arthritis in the posterior astragalo-calcaneal joint was admitted to Professor Slomann's Clinic. The obstinate character of the symptoms made us suspect that it might be a case of tuberculosis, but we could find nothing abnormal at the roentgenographic examination. Professor Slomann then gave the patient a small injection of carbolic acid water in the joint. The symptoms did not disappear, and roentgenograms were taken every few weeks. About 4 weeks later some well-marked structural changes began to appear in the posterior portion of the astragalus just above the joint, showing a spotted and blurred contour which coincided quite well with the picture one finds in the acute bone atrophy. We interpreted it, however, as a tuberculous bone focus which also Dr. Chievitz, who had examined the patient, was most inclined to think. We operated on the patient and found the bone soft, and fairly easy to remove to the extent indicated by the focus in the roentgenogram, but we found no certain signs of tuberculosis. Microscopic examination (Dr. Hörring) did not reveal any tuberculosis or other inflammatory changes, but small and well-defined islands of hyaline cartilage poor in cells were seen scattered about in the bone tissue.

By animal experiments carried out during my investigations of the pathogenesis in Ollier's disease I have reached the result that a cartilage meta-

plasia of this kind is easily produced in normal bone tissue; should it constitute a normal stage of development in the acute bone atrophy, then it seems to me as if the matter in question should be considered in a different — but not in a clearer — light.

4. P. Flemming-Möller, Copenhagen: With regard to Dr. Bentzon's statement I should like to remark that in the pathology of bone, at all events according to Axhausen, one never finds a metaplasia of bone tissue to cartilage, whereas the reverse phenomenon is not at all rare.

5. H. J. Panner, Copenhagen: In connection with Dr. Flemming-Möller's statement I should like to express my astonishment at the formation of hyaline cartilage. I think it rather unlikely that this formation is in reality a new formation.

6. P. G. K. Bentzon, Copenhagen: I want to pointo ut to Dr. Flemming-Möller and to Dr. Panner that the cartilage metaplasia in my rabbits (which were treated by alcohol injections round the nutrient arteries) appears to such an extent — fairly great quantities of hyaline cartilage are produced — that its existence can not be denied.

7. Chr. I. Baastrup, Copenhagen: To Dr. Flemming-Möller: On page 32 line 13 from the bottom[1] I mention acromegaly as an instance of the influence that endocrinic glands may have on the bone tissue.

My ideas of the inactivity as a cause of the bone atrophy are not based upon one single case but on a whole series of cases and various arguments.

With regard to the question of halisteresis and osteoporosis the verified disappearance of bone elements owing to the action of osteoclasts may explain the reduced weight of the bone. Yet, this question has not been definitely answered, but from what has appeared in the literature (Exner) there is every reason to believe that what I have said in connection with these processes is correct. Exner found the proportions of the organic and inorganic matter in normal bones to be the same as in rarefied bones, about 60 % of lime — only in one case did he find the amount of lime in the rarefied bone to be 10 % less than in normal bone. In co-operation with Mr. Marcussen, the chemist, I have attempted to solve this problem, but the experiments were unsuccessful.

To Professor Forssell: The term »lipomacie» has been advanced by Krause. I have thought it serviceable in such cases where one desires to signify »fatty degeneration of bone».

With regard to the symptoms I just want to say that in the material (700—800 cases from the Workman's Insurance Commission) which I have examined, I have found symptoms, especially pains, in a remarkably great number of cases where there has been a loss of bone substance.

Whether these pains are due to changes in the articular capsule, in the muscles, or in other soft tissues (e. g. oedema), or to changes in the bone tissue, may be doubtful — my belief is that all these factors may come into consideration.

As the rarefied bones become softer and more brittle it seems to me

[1] Acta Rad. vol. II fasc. 4—5 pag. 395.

that, theoretically, one might well believe that weight-bearing is able to cause pains.

Tumours have been stated by KIENBÖCK as a cause of the acute bone atrophy. I have quoted this statement but I do not share his view. Like Professor FORSSELL I think that other conditions than inactivity may come in as a cause of the rarefaction, — I mentioned thrombus caused by trauma or by bacterial toxins, and further the effect of bacterial toxins on the nerves — but I do not think, as KIENBÖCK does, that tumours are active via a reflex trophic path.

II. H. J. Panner, Copenhagen: Separations from the Capitulum Humeri and their Consequences[1]

The separation from the capitulum humeri found in »osteochondritis dissecans» (König) is considered by the author to be the most common cause of arthritis deformans cubiti. In the early stages of the disease one finds only a rarefaction in the capitulum humeri, varying in size and intensity. Later on one may see the shadow of a free body, deformity of the articular surfaces, and, finally, a typical picture of a more or less pronounced arthritis deformans. Also in the final stage of the disease one may find irregularities in the capitulum humeri, either in the form of changes in its internal structure or in the form of a flattening out of the articular surface, or both of these changes simultaneously. The author considers the Roentgen pictures to be pathognomonic and that the Roentgen examination in most cases reveals the cause of the disease even many years after its commencement.

Discussion:

1. S. A. HEYERDAHL, Christiania: In connection with Dr. PANNER's paper it would be greatly interesting to know whether this disease has been found bilateral, and how often. Osteochondritis dissecans of the knee-joint, which Dr. PANNER mentioned as being the same disease, occurs of course frequently bilaterally, without morbid symptoms from one of the knees, whereas the roentgenological picture is equally marked in both knees.

2. P. G. K. BENTZON, Copenhagen: Being an orthopedist who now and then has to treat cases of this kind I should like to ask Dr. PANNER a question. As I understood Dr. PANNER, these cases always end with the formation of a floating cartilage. Is that the case? This question is of course very important for our choice between operative and conservative treatment if we get the patient under our care in the first stage of the disease, where only the rarefactions are present.

At present we have a case of this kind, with the disease localized to the knee. I have roentgenologically controlled the changes during half a year, and I have noticed such distinct — clinically and roentgenologically — tendencies to healing that I have not found any indications for an operative treatment.

3. H. J. PANNER, Copenhagen: To Dr. HEYERDAHL: The changes of which I have demonstrated some roentgenograms originate undoubtedly from the

[1] Published in Acta Rad. vol. III fasc. 2—3 pag. 129.

disease »Osteochondritis dissecans» described by KÖNIG. It is certainly very often bilateral. In spite of our bilateral examination not having been sufficiently systematic, changes have nevertheless been found on both sides in 25 % of the cases.

With regard to Dr. BENTZON's remarks I want to state that it is not necessary that a fragment is separated, but that a healing may take place spontaneously, though certainly only in some few cases. Such cases have been published regarding the knee by TROELL and MORCEAU, but I have a feeling that the progress of the disease in the two joints is somewhat different.

On the whole, I do not think one ought to wait too long with the operative intervention and the operation should include not only a removal of an eventual floating cartilage but also of a flattening and cleaning up of its original site. In this way I think one may save many patients from a tiresome invalidity.

If there is originally an arthritis deformans, then it is certainly difficult to stop its development.

III. H. Laurell, Upsala: Some Cases of Volvulus

L. demonstrated some roentgenograms of 9 cases of intestinal volvulus (of the small intestine and of the sigmoid flexure) and pointed out the value of the roentgenoscopy, especially in certain forms of volvulus which can not be diagnosed clinically.

The roentgenoscopic examination is done in the first place without the aid of any contrast meal and, if possible, later on with the aid of a contrast enema (eventually in combination with inflation with air).

The following classification is suggested with regard to volvulus of the sigmoid flexure:

A. Physiological forms.

B. Pathological forms.

I. »Pure» cases. True volvulus.

a. Volvulus with *great dilatation* of *the sigmoid flexure* and eventually also of the portions of the intestine situated above. In these cases there is a distinct obstruction of the passage. Strangulation of vessels in the mesosigmoid may be present or not. The colon sigmoideum is much distended with gas and liquid contents.

b. Volvulus *without pronounced dilatation but with venous stasis or hemorrhagic infarction* of *the sigmoid flexure* owing to strangulation of vessels in the mesosigmoid. The obstruction is not complete. The cases are attended with intestinal hemorrhage and are easily mistaken for duodenal ulcer, especially if the twisting is spontaneously reduced.

II. »Mixed» forms.

Here we find a volvulus without strangulation of the vessels or a tendency to volvulus (a long sigmoid loop with a narrow or comparatively narrow peduncle). These cases are attended with a relative intestinal obstruction, permanent or intermittent, which manifests itself as meteorism and obsti-

pation. Twistings of the long intestinal loop, formations of kinks and valves, and a pellotte action excerted on empty loops by other loops highly inflated with gas may create variable mechanic conditions that are favourable for the production of an obstruction of the passage. This obstruction is usually moderate but may increase to a genuine ileus, or else a true volvulus (I) may set in. Some cases of Hirschsprung's disease belong to this group.

L. tries also to explain the manner of origin and reduction af a volvulus of the sigmoid flexure, and with regard to non-fixed volvulus loops he recommends to try to reduce them in a bloodless manner by turning the patient round in a suitable direction previously determined by the roentgenoscopic examination. One of his volvulus cases was spontaneously reduced during the roentgenoscopic examination. Turnings and rapid movements of the body may cause the twisting of a loop of the sigmoid provided the necessary anatomical conditions are present. An important condition for the arising of such a volvulus seems to be that the two limbs of the sigmoid are filled up with contents of different specific weight (for example gas and fluid). The absolute weight of the two limbs is, according to L., of less importance.

If, owing to a relative gas-obstruction in the region of the sigmoid flexure, the colon be filled with gas, secondary symptoms may arise which are important to remember. Interposition of the colon between the diaphragm and the liver, as well as »*reitender kaskaden-Magen*», may thus be explained sometimes, for a gas-filled intestinal loop tends to »rise» above loops that are not gas-filled and it has also a direct raising effect on the adjacent organs, like that of a floating dock.

Discussion:

1. S. Ström, Umeå: In connection with Dr. Laurell's paper I should like to show two cases of intestinal obstruction. The first one is a case of invagination far down in the small intestine. In the roentgenograms of the intestinal tract the abdomen was seen filled with greatly dilated intestinal loops. A portion of the ileum close to the ceacum did not fill, however. On operation we found here a tumour in the small intestine, a fibroma, which had caused an invagination.

The second case showed a great dilatation of the ileum and most of the jejunum. Also the caecum and the appendix were highly dilated, the appendix being as thick as a little finger. The ascending colon was also dilated but incompletely filled. On operation a constricting cancer was found in the upper portion of the ascending colon. The dilatation of the appendix and of the distal portion of the ileum that was seen in the roentgenogram went to show that the obstruction was situated distal to the caecum. In this case an appendicostomy was performed as a preparatory operation, to which the dilated appendix was particularly suited. Proving the dilatation of the appendix in a case of intestinal obstruction may be of some practical use in this respect.

IV. Åke Åkerlund, Stockholm: Diverticula of the Stomach from a Roentgenological Point of View[1]

The scant statements found in the Roentgen literature as to diverticula of the stomach, relate with two exceptions to so-called »functional» diverticula of the stomach, all of which, in the opinion of the author, are misinterpreted diverticula of the small intestine, situated behind the stomach and originating from the terminal part of the duodenum or from the region of the duodenojejunal flexure.

The author reports on a series of five of his own cases of roentgenologically diagnosticated organic diverticula of the stomach, four of which belong to the type of »congenital» diverticula and are localized to the cardiac region, the fifth one being a case of post-operative diverticulum within the canalis ventriculi, verified and removed at the operation.

The diverticula of the stomach are of the greatest roentgenological interest from a differential-diagnostic standpoint. Roentgenologically they are characterized by a rounded shape, varying degrees of filling and distention, soft and mobile contour, absence of roentgenological symptoms of infiltration processes in their surroundings. All five cases of diverticula of the stomach showed residues of the barium meal after 4 hours and each of the four cases of cardiac diverticulum exhibited in erect posture a gas bubble in the upper portion of the diverticulum. (Author-report.)

Discussion:

1. H. J. Panner, Copenhagen: I ask Dr. Åkerlund if it is not possible that some of the cases that have been demonstrated were diverticula in the lowest part of the oesophagus. I myself have never seen decided diverticula of the stomach but I have seen a congenital diverticulum in the lowest part of the oesophagus in a child three or four years of age. Besides the diverticulum there was also a spasm higher up in the oesophagus. The spasm was removed by the narcosis but the diverticulum remained unchanged.

2. Åke Åkerlund, Stockholm: I have devotod my attention just to this possibility that it might here have been a question of diverticula of the oesophagus. By the roentgenoscopic examination we have, however, in all cases been able to exclude this contingency. The patients have been examined from different directions when swallowing the barium meal. Its passage down through the oesophagus has been quite unimpeded and the diverticula in the cardiac region have proved to be situated in the stomach distinctly behind the inlet of the oesophagus.

[1] Published in Acta Rad. vol. II fasc. 6 pag. 476.

V. T. Larsén, Orebro: Some Cases of Benign Tumours of the Stomach, Illustrating the Differential-Diagnostic Value of the Movements of the Mucous Membrane[1]

The speaker pointed out how in suitable cases it is possible by a close study of the gastric mucous membrane to diagnose benign tumour with greater certainty than before. He demonstrated lantern slides of two cases where the mucous membrane of a circumscribed tumour area was variable in the serial plates and he therefore considered the diagnosis benign tumour likely. This diagnosis was verified by the subsequent operation.

(Author-report).

VI. Chr. I. Baastrup, Copenhagen: Methods for Obtaining Pictures of the Mucous Membrane of the Stomach[2]

Dr. BAASTRUP described two methods:

1) Inflation of the stomach with air saturated with barium powder (similar to a method advanced by LAURELL for the examination of the colon). The powder settles upon the moist walls of the stomach. The method is difficult to employ.

2) This method is based upon physiological studies of rat stomachs, by which it has been shown that the food latest partaken of gets inside of the food first ingested. First of all half a table-spoonful of barium meal is given and then 200 à 300 grams of rice-flour porridge of a fairly thick consistence. The mucous membrane of the stomach will then exhibit a reticular or striped appearance in the picture. In the erect posture almost all of the folds of the mucous membrane are frequently seen running in a longitudinal direction as far as the greater curvature. Especially the conditions of the fundus are distinctly seen by this method, thus, a transverse fold from the cardia is very frequently observed. This fold does not seem to be due to pressure from the colon.

If, after having taken one picture of the mucous membrane, barium water is administered, one will find that the barium water takes a perpendicular course and does not follow the lesser curvature. (If an ordinary contrast meal is first given and then a glass of water, one will find that the water settles *on the top* of the barium meal as an intermediary layer). The theory of sulcus sive canalis salivalis as a groove close to the lesser curvature, through which water can pass the other contents of the stomach, is therefore wrong. A factor of the utmost importance for the distribution of the food in the stomach is the specific gravity of the food stuffs. As far as I am able to judge, this factor has never been considered in the right manner. GROEDEL's results, for instance, of his investigations concerning the movements of the stomach are therefore erroneous to a very great extent.

This method has been employed only in quite few pathological cases

[1] Will be published in extenso in Acta Radiologica.

[2] Published in Acta Rad. vol. III. fasc. 2—3 pag. 180.

A case of ulcer of the stomach exhibited a very marked filling with barium meal of a niche-resembling area. It was a case of an hour-glass stomach, but there was no operation or post-mortem examination to prove or disprove the diagnosis of ulcer of the barium-filled area.

In a case of tumour of the fundus of the stomach, the picture obtained by method No. 2 revealed a great number of details with regard to the extension, shape and appearance of the tumour, details which by no means could have been recognized in a picture taken after the Rieder test meal.

(Author-report.)

Discussion:

1. GÖSTA FORSSELL, Stockholm: The deformity of the bulb that occurs in duodenal ulcer is, as is well known, interpreted by ÅKERLUND as the result of a spasm of the *muscular layer*. A rounded »contralateral defect» is said to be produced by a contraction of the circular muscles opposite the ulcer which may appear as a *niche-shaped* shadow, most often in the vicinity of the lesser curvature; a »retraction» of the medial surface of the duodenal bulb is said to occur owing to a contraction of the longitudinal muscles in the lesser curvature. Through this contraction the »medial recess» between the pyloric sphincter and the muscular wall would be obliterated.

To this view I have objected that in considering the Roentgen picture of the duodenal bulb ÅKERLUND as well as his predecessors *have taken as their ground the supposition* that the *mucous membrane of the duodenal bulb is devoid of folds*. This supposition is *not correct*, as the mucous membrane of the duodenal bulb even under normal conditions may, as I have shown, exhibit numerous folds of various types.

I will now give an account of a case that illustrates the great part taken by the folds of mucous membrane also in the formation of the »typical» deformity observed in the roentgenogram of the duodenal bulb when it is ulcerated.

It relates to a man 32 years of age who for a year exhibited symptoms of duodenal ulcer with severe periodical pains. A strict ulcer cure had not brought any result. At the Roentgen examination (15/2/1923) there was to be found a constant reduction of the lumen of the duodenal bulb with a rounded defect on the lateral surface of the bulb and a »retraction» of its medial surface, as well as an *obliteration of the medial portion of the bulbar recess*. The *lateral* portion of the *recess*, on the other hand, seemed *dilated*. Opposite the defect in the vicinity of the lesser curvature a dense contrast spot was seen which was interpreted as *probably* produced by an *ulcer niche*. Great local pressure tenderness of the duodenal bulb. Here was, thus, a »deformity» which in an eminent degree resembled the one described by ÅKERLUND as typical of duodenal ulcer. The patient insisted on being operated upon. — The operation, resection by incision through the proximal portion of the pyloric canal of the stomach and through the distal portion of the duodenal bulb, about 2.5 c.m. from the pylorus, with application of Billroth II, was performed by Dr. ABRAHAM TROELL. Through the obligingness of Dr. Troell I was given the opportunity of immediately preserving the specimen in a 5 per cent. formaline solution where it was kept for two hours, after which it was transfered into a 2 per cent. formaline solution. In this way I managed to preserve the state of contraction of the muscular wall

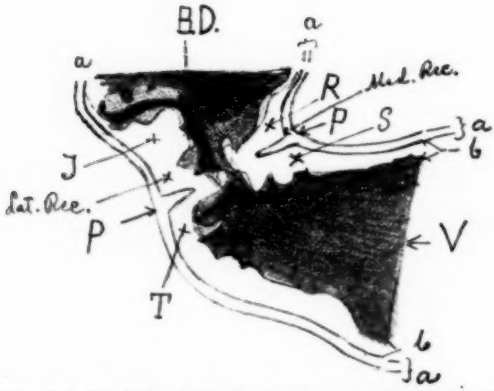

Fig. 1 shows a picture with the front of the specimen against the plate and the pylorus rotated slightly forward (to the left).

and mucous membrane that existed at the operation. My intention was to *fill the lumen of the specimen* with some *contrast agent* and then to take *roentgenograms* of it. By comparing the roentgenograms of the specimen, partly with the roentgenograms of the same part obtained during life and partly with the mucous membrane and muscular wall of the anatomical specimen, one might under favourable conditions get an opportunity of ascertaining *what anatomical formations produce the typical deformities observed in the roentgenograms of the bulb in duodenal ulcer.*

Having thus been hardened for 24 hours the lumen of the specimen was carefully filled with bismuth vaseline having a temperature of about 40° C, the specimen having previously been warmed in water with a temperature of about 38° C. By suitable manipulations we succeeded in filling the whole of the lumen with bismuth vaseline which was then allowed to harden. Roentgenograms of the specimen were taken from different directions.

These roentgenograms were found to coincide quite well with the pictures obtained during life, as far as the typical deformity was concerned, but no niche-shadow could be detected.

The external muscular surface having been dissected out and the visible parts of the specimen inspected, the specimen was cut open along the lesser curvature and the *surface of the mucous membrane was exposed.*

Now, what anatomical formations are found, on closer inspection, to cause the described typical deformities of the duodenal bulb?

Figs. 1 and 2 are drawings of the roentgenograms of the specimen when filled with contrast paste, and further, the *external muscular wall* and the *pyloric sphincter* have been put in, faithfully copied from the anatomical findings.[1]

These pictures give a good idea of the anatomical basis for the bulbar deformities in duodenal ulcer.

[1] Lantern slides of serial pictures taken before the operation as well as slides of the anatomical specimen and its roentgenograms were demonstrated during the reading of this paper. These slides will be reproduced in a more detailed publication.

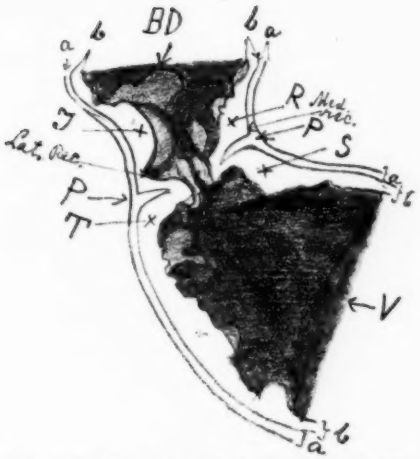

Fig. 2 shows a similar picture, but the pylorus is here rotated slightly backward (to the right).

Already at the first inspection of the excised specimen one was able to ascertain that the *external muscular wall* (a) *of both the duodenal bulb and of the pyloric canal* was *perfectly smooth* and that the basal portion of the bulb had the same outer width as the canal.

The sphincter muscle of the pylorus (P) forms the typical disc that separates the pyloric canal from the duodenal bulb.

Between the pyloric disc (P) and the muscular wall (a) there is a distinct circular recess with a medial (Med. rec.) and a lateral (Lat. rec.) portion.

It is therefore obvious that, at least in this case, the muscular wall *does not* protrude into the bulbar lumen, and that the *circular recess on neither side is obliterated through a contraction of the muscular wall.*

High and broad folds of mucous membrane reduce, on the other hand, to a large extent the lumen of the bulb.

On the lateral aspect of the duodenal bulb the mucous membrane forms a *high cushion of folds* (I) which produces the rounded ›defect‹ in the corresponding region of the outline of the roentgen picture. Proximal to this cushion of mucous membrane, the membrane itself is thinner and forms a *pocket* or *recess* (Lat. rec.) in the region of the lateral portion of the circular recess between the pyloric disc and the muscular wall of the bulb. The angle between the pyloric sphincter (P) and the muscular wall (a) on the side of the lesser curvature (= Med. rec.) is, on the other hand, completely filled up by a swelling of the mucous membrane (R), and in this way the ›retraction‹ of the contour of the lumen on this side is produced, so that the *medial contour of the mucous membrane in the roentgenogram merges into the upper contour of the pyloric lumen.* Short longitudinal folds of mucous membrane are running within the pyloric lumen itself.

Within the *stomach* (V), too, a swelling of the mucous membrane (T, S) fills up the circular recess at the bottom of the pyloric canal, and the mucous membrane (b) shows some broad transverse folds. — The gastric mucous

membrane of the anatomical specimen showed further a form of contraction with a finely padded surface (État mamélloné).

From this examination it is obvious that in this case the »typical» bulbar deformities, both the rounded »defect» on the lateral aspect of the duodenal bulb and the »retraction» on its medial aspect, are produced by *mucous membrane formations.*

Time does not permit a further discussion of the possible causes of the varying form and position of these folds of the mucous membrane, or of their origin.

It is quite certain, however, that in many cases they vary very much as to form and size during the Roentgen examination, and thus they are certainly not produced by organized infiltrations of the mucous membranes, but by a similar mechanism as that which causes the normal variations of the mucous membrane of the duodenal bulb (probably a varying amount of fluid and varying contraction of the muscularis mucosae). To some extent, however, the swellings of the mucous membrane are no doubt in many cases produced by some more or less organized inflammatory infiltrations and are then of a more permanent character.

The *ulcer* itself could not be detected in the roentgenograms of the specimen. In any case, there was no niche-shaped protrusion in any of the projections of the specimen (six different projections). At the operation, however, a thickening of the serous membrane had been noticed and a swelling of the anterior wall of the duodenal bulb had been felt over an area one c.m. in diameter close to the greater curvature. And, in fact, when the specimen was cut open one found at this spot an irregular triangular ulcer of about 6 by 9 millimeters in size, perforating the entire thickness of the mucous membrane and the muscular wall to the thickened serous membrane, and situated at the bottom of a groove between two broad folds of mucous membrane which were lying close together and hiding it completely.

The small contrast spot close to the medial contour of the duodenal bulb, which in the roentgenogram intra vitam was suspected of possibly being a »niche-shadow», did not coincide with the ulcer as to its position nor was it so typical as to permit of any sure conclusions.

This case also shows that a fairly large ulcer can be hidden in the roentgenogram by folds of mucous membrane covering it.

2. H. J. Panner, Copenhagen: I ask Professor Forssell, whether he thinks that a normal duodenal mucous membrane in spasm can give pictures similar to those in ulcers, or if from the characteristic deformities of the bulb of the duodenum it is possible to conclude that an ulcer is in all probability present.

3. Gösta Forssell, Stockholm: Dr. Panner has put the question to me whether in *normal* cases I have observed roentgenograms similar to those found in ulcer of the duodenal bulb.

To this I can answer that in several cases where there has been no reason to suspect a duodenal ulcer I have seen *momentary* contraction pictures that have *very much* resembled even the »typical» deformity with its »retraction» and »incisura». Agreeing with Åkerlund, I for my part consider the typical niche-shadow the most reliable ulcer sign, that is, if the niche-shadow shows itself as a well-defined contrast spot denser than its surroundings and recurring in several roentgenograms. Such a »*niche-shadow*» does, in my opinion, not always with certainty correspond to the cavity

of the ulcer, but may just as well be some retained, sedimentary contents located between abnormally stiff and immovable folds of mucous membrane in the surroundings of the ulcer. If the niche-shadow be not present, one has to be particularly careful in estimating the »spastic» phenomena (= mucous membrane formations). Many diseases of the digestive organs may, as we know, cause a *reflex* »spasm» (= a folding of the mucous membrane) in the duodenal bulb, producing a picture that reminds of the »defects» in ulcer. I feel fully convinced that one has to be quite particularly careful also in diagnosing »*adhesions*» on the basis of »protrusions» or »indentations» in the bulbar shadow. The bulbar »deformities» described in this connection are undoubtedly most often (if not always) caused by deep *folds of mucous membrane*, — possibly produced by reflex action through adhesions.

However, what I consider extremely suspicious symptoms of ulcer are, firstly, a *defect* of the bulbar lumen, in *the form of a cushion of mucous membrane bulging into the lumen, and obstinately persisting for a long time* in spite of compression of the bulb, and, secondly, a *local dilatation* of the *bulbar recess* proximal to a persistent unilateral or circular swelling of the mucous membrane.

VII. M. Simon, Stockholm: Large Intraparietal Gastric Hernia, Simulating a Hernia through the Diaphragm

Demonstration of radiograms of a married woman, 60 years of age, clinically suspected of suffering from cholelithiasis or possibly of stenosis of the cardia. Periodically during the last 10 years she has had attacks of vomiting, sometimes in combination with severe pains in the epigastrium. — Above the shadow of the diaphragm the plates reveal a large barium-filled sac, obviously corresponding to the upper part of the stomach and situated anterior to the intraabdominal part of the stomach. At the operation the hernia was found to have protruded from the abdomen, not between the sternal and costal portions of the diaphragm but through the deepest layers of the anterior abdominal wall. The hernia seemed to have followed the ligamentum teres and was situated just above the upper sharp edge of the unusually well-developed transverse fascia, behind the sheath of the rectus muscle.

In connection with this case two Roentgen-diagnosed cases of partial eventration of the stomach through the dilated hiatus diaphragmaticus were shown; in one of these cases the diagnosis has been verified by operation.

Attention was called to the possibility that some of those cases which have been diagnosed supradiaphragmatic diverticula of the oesophagus in reality have been cases of the kinds described above.

VIII. S. Ström, Umeå: A Contribution to the Roentgen Diagnosis of Ulcus Pepticum Jejuni[1]

The indirect ulcer symptoms are of little value as far as the Roentgen diagnosis of the peptic jejunal ulcer is concerned, just as is the case with

[1] Published in Acta Rad. vol. II pag. 468.

regard to the gastric and duodenal ulcers. In a gastro-jejunal ulcer a niche may be well marked in the gastro-enterostomy opening, although it is difficult to verify. Serial photography is necessary for that. The emptying through the gastro-enterostomy can take place rapidly in spite of a crater-shaped ulcer in the gastro-enterostomy opening.

In a peptic jejunal ulcer a niche is easy to observe, though more difficult than in the stomach and duodenum, on account of the transverse mucous folds in the jejunum. Besides the niche a local spasm also occurs as an ulcer symptom, which spasm may either manifest itself as a contraction of the circular muscles of the intestine, analogous to the spastic contraction of the stomach or duodenal bulb, or as a contraction in the intestinal wall, probably chiefly in the muscularis mucosae, which causes the folds of the mucous membrane to draw so close together that the digestive chambers between them are obliterated. In the Roentgen picture the contour of the jejunum in the neighbourhood of an ulcer is therefore smooth, without any visible folds, and retracted. This is especially seen on the side of the intestine where the lesion is situated.

Four cases are reported: one having a niche-shaped gastrojejunal ulcer, two having a niche-shaped jejunal ulcer, and one a jejunal ulcer with a typical spasm but without any sure niche, which had been healed by internal treatment (roentgenologic control.)

Discussion:

1. CH. I. Baastrup, Copenhagen: I want to thank Dr. Ström for his interesting communications. But I will remind that in all cases where a gastro-enterostomy has been performed, there have been a great many adhesions and these may be of different form and extension and give a very varied picture. Furthermore, a finding differing at different examinations may be due to other causes than spasms which relaxe. For instance, adhesions may also disappear.

Therefore I think one must be extremely careful of the diagnosis niche in the small intestine.

2. G. Bohmansson, Umeå: I hope you will pardon that I, being a clinician, venture to express an opinion at this meeting, but the peptic ulcer diagnosis is so difficult that it is higly important to elicit how much help the roentgen diagnosis *is really able* to render in this respect. I agree with Dr. Ström in that we must be very careful of a diagnosis based upon indirect symptoms, as one very often finds cases of jejunitis and duodenitis with a considerable cell-infiltration both in the mucous membrane and in the muscularis mucosae, whether an ulcer be present or not. This has been proved by microscopic examination of a great number of cases where resection has been done; in certain cases the infiltration in the intestinal wall has gone so far as to produce real phlegmons where the intestinal lumen in the roentgenogram has been constantly constricted, without any organic stenosis having been present.

3. Gösta Forssell, Stockholm: In his paper on the roentgen diagnosis of ulcus pepticum jejuni Dr Ström points out that there are certain *local* signs of these ulcers that are analogous to the ulcer signs in the stomach and duodenum.

As direct local symptoms of the peptic ulcer of the jejunum Dr. Ström mentions first the *niche*, and, secondly, some *spastic symptoms*, viz. a contraction of the circular muscles toward an ulcer in the jejunum, analogous to the spastic constriction found in connection with gastric and duodenal ulcers, and a spasm which may be localized chiefly to the muscularis mucosae. As a result of this spasm of the muscularis mucosae »the mucous membrane in the neighbourhood of the ulcer does,» according to Dr. Ström, »show a smooth contour *without folds*». In his description of his pictures Dr. Ström repeatedly emphasizes as typical for the spastic signs of the peptic jejunal ulcer that »the folds in the neighbourhood of the niche are obliterated.»

In agreement with Dr. Ström, I consider we ought to try to find the local changes of form which are typical for the peptic jejunal ulcer and I also think that the roentgenograms demonstrated by him are in all probability showing changes which are caused by a peptic ulcer in the jejunum. — But I cannot share his view with regard to the *anatomical basis for the described changes.*

First of all I want to point out that we do not yet know sufficiently in detail the *normal Roentgen picture* of the gastroenterostomy and of the jejunal loop close to it. The roentgenograms must be studied with special regard to the fact that the *mucous folds of the small intestine* are, as I have shown, *motor phenomena* and not *fixed formations.*[1] We do not know as yet to what extent the folds in the neighbourhood of a gastro-enteroanastomosis are *normally varying* under different conditions and therefore we are not able to decide with any certainty what kinds of contraction are pathologic.

Dr. Ström is of the opinion that the narrowing of the lumen which may occur in the region of the jejunal ulcer is caused by a *contraction of the circular muscles towards the ulcer*, and that the picture is further characterized by the *absence of folds* of the mucous membrane in the neighbourhood of the ulcer.

On the strength of the knowledge I have of the anatomy and motor phenomena of the mucous membrane of the intestines I consider it, on the contrary, extremely probable that here — just as in the case of a duodenal ulcer — the narrowing of the lumen as well as the abnormal contours of the lumen are *chiefly caused by particularly high and broad folds that differ from the usual kinds of contraction folds.*

Fig. 1 represents a drawing of a case similar to the one demonstrated by Dr. Ström as his Case II. Besides the silhouette of the lumen which is filled with contrast paste I am also showing with a *dotted line* the course, which, in my opinion, is the probable one, of the *outline* of the stomach and the jejunal loop in the vicinity of the gastro-entero-anastomosis. By this means *the part taken by the mucous membrane in the shaping of the lumen will be apparent.*

In some few cases I have had the opportunity of observing a *niche* in the roentgenogram of a peptic ulcer of the efferent loop of a gastro-entero-anastomosis and I have then also observed a — frequently changing — narrowing of the lumen on a level with the niche. One may then happen to find the rounded defect opposite the niche which Dr. Ström has described (V_2, Fig. 1), and the contour *seems* at a first glance to be devoid of folds in this region. If one looks closer, however, one will see partly that the

[1] The American Journal of Roentgenology 1923, N:o 2.

contour has here and there indentations *corresponding to the edge of folds*, and partly that *outside of it* there are *ribbon-like shadows corresponding* to thin layers of contrast agent between the compressed folds, and this was obviously also the condition in some of Dr. STRÖM's cases, e. g. Case II.

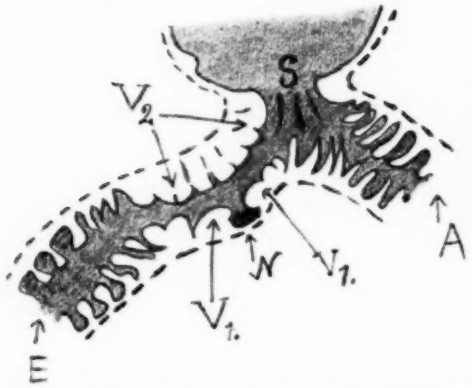

Fig. 1. S = the stoma of the gastro-entero-anastomosis: A = the afferent jejunal loop; E = the efferent jejunal loop; N = the niche; V_1—V_1 = high folds of the mucous membrane, surrounding and forming the niche; V_2 = high and broad folds, closing up together and forming a cushion that protrudes into the lumen. The *dotted line* indicates the probable outline of the stomach and the jejunal loop in the vicinity of the gastro-entero-anastomosis.

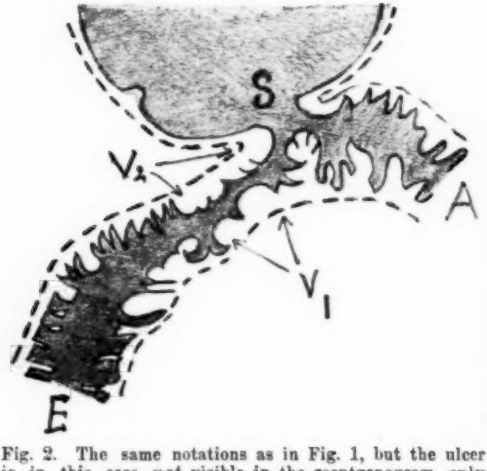

Fig. 2. The same notations as in Fig. 1, but the ulcer is in this case *not* visible in the roentgenogram, only the broad folds in its neighbourhood.

In many cases one is also able to observe how distinct grooves are filling between these folds in the region of the narrowing. It is therefore in some cases quite certain, and in the other cases, in my opinion, extremely probable that the rounded incurvation into the lumen, »the spastic defect», opposite the niche is here — just as in the duodenum — caused by a *mucous membrane cushion protruding into the lumen*, which cushion has been formed by the closely packed and broad folds being compressed.

The retractions (V_1—V_1) at the side of the niche (N) have, in my opinion, every criterion of *not* having arisen by the protrusion of a *thin* and *fold-less* mucous membrane, but just of being formed by *broad and high folds of mucous membrane surrounding the ulcer and probably contributing to an essential degree to the formation of the niche.*

In support of his supposition that the mucous membrane in the vicinity of the ulcer is typically *devoid of* folds, Dr. STRÖM states that *Bland-Sutton* has in one case found the mucous membrane surrounding the jejunal ulcer to be abnormally thin and resembling the mucous membrane of the duodenal bulb. This is, of course, no proof to us who know that the mucous membrane of the duodenal bulb *during live* has very high and numerous folds and a very variable appearance, though the

mucous membrane is most often smooth at the post mortem examination. And I have just had the opportunity of showing how also the typical deformities of the bulb in duodenal ulcer are probably due to abnormally high and broad folds of mucous membrane and not to contractions of the muscular wall.

With regard to the *niche shadow*, I consider it the most reliable sign of an ulcer. Concerning my view of its anatomical basis, I refer to what I have just said about the roentgenologic symptoms in duodenal ulcer. Unfortunately, a *reliable* niche shadow is still a comparatively unusual finding in clinical symptoms of a peptic jejunal ulcer.

The *narrowing of the lumen* of the jejunum (Fig. 2) *without* a visible niche may be explained in the same manner as in the case of a niche-shaped ulcer, by the fact that the *lumen is for the most part filled up by broad and closely packed folds of mucous membrane* (V_1 and V_2) which are pressing tightly together.

We do not yet possess sufficient experience to be able to decide with certainty in each separate case whether such a narrowing of the lumen is caused by a *pathological process* owing to an *ulcer*, or whether it is caused by a »normal» motor mechanism of the mucous membrane in a gastro-entero-anastomosis.

4. S. Ström, Umeå: As I have just pointed out, I believe that the spastic phenomena take an essential part in producing the typical picture seen in the proximity of a jejunal ulcer: the obliteration of the valvulae conniventes. However, I suppose that Professor Forssell is of the same opinion as I am, as I also pointed out that organic changes, such as induration in the neighbourhood of the lesion and oedema of the mucous membrane, may be conducive to the production of this picture. Indurative changes in the surroundings of a peptic jejunal ulcer are rather common, according to Carman. I think Professor Forssell is of the same opinion, even though he did not lay particular emphasize on it.

5. Gösta Forssell, Stockholm: I just want to make the remark that in my paper on the motor mechanism of the mucous membrane of the intestinal tract I have pointed out that *the folds of mucous membrane are formed not only through different contractions of the muscularis mucosae* but also to a very great extent through a *varying supply of fluid* in the mucosa and submucosa, and thus the *mass* of the mucous membrane may vary quite considerably at one and the same place. In a *pathologic* process in the intestinal wall, such as inflammation round an ulcer, it is, of course, highly probable that bulgings are formed in the mucous membrane, not only through the *normal* mechanism of the supply of fluid to the mucous membrane, but also through a *pathologic* collection of fluid, such as oedema, exudate or abnormal hyperemia of the mucous membrane. And it is, of course, rather certain that a swelling due to such a distention of the mucous membrane must become apparent in the roentgenogram. The fact that the narrowing of the jejunal lumen in several of Dr. Ström's cases has been *temporary* and changing, makes it probable, however, that an organized infiltration has not been the cause of the narrowing in these cases.

IX. C. G. Jansson, Helsingfors: Some Experiences of Pneumoradiography of the Kidney

In reference to fifteen cases where pneumoradiography of the kidney has been performed according to the Rosenstein method a mention is made of technical details, complications and the diagnostic value of the method. The injection of the oxygen has been done with SAUGMAN's pneumothorax apparatus and a puncture needle. It is recommended as a measure of precaution to make a radiographic determination of the position of the first lumbar vertebra and to make a mark on the needle to show the depth of the puncture. Sharp contours of the kidney have been obtained in all cases where the gas has been injected. In two cases where the gas could not be injected the diagnosis profited by the actual puncturing, as in one of these cases tuberculous pus issued forth through the needle, and in the other, a clear fluid from a cystic kidney. In neither of these cases it was possible to introduce the gas into the kidney bed by correcting the position of the needle. Perirenal adhesions or perhaps a reduction of the fatty capsule of the kidney were probably present. In one case the injection of the gas had to be interrupted because the pressure of the gas on the greatly infected bladder caused violent pains. In one case a state of collapse of short duration was produced in connection with the introduction of the gas.

On account of the possibilities of complications occurring by this method and because a well-marked kidney contour can only in very few cases give us such diagnostic informations as can not be obtained by other means the opinion is expressed that the indications for radiography of the kidney should be extremely limited.

(Author-report).

X. H. Laurell, Upsala: On the Differential-Diagnosis: Pyonephrosis or Retroperitoneal Tumour

Dr. LAURELL reported on a case of pyonephrosis, the roentgenological picture of which led to the faulty diagnosis retroperitoneal tumour. As usual in an extra-renal pelvic dilatation the lower pole of the diseased kidney was displaced laterally by the dilated renal pelvis. The introduced ureteral catheter described a curve round the lateral side of the visible rounded shadow of the renal pelvis. This was not due to the catheter having been pushed up so high that it was pressed against the internal surface of the kidney and so became bent, but to a rather unusual starting point of the ureter on the lateral side of the dilated extrarenal pelvis. The roentgenogram conveyed the impression that both the ureter and the kidney had become displaced laterally by a tumour growing on the medial side of the kidney. At the pyelography the dilated extra-renal pelvis did not fill, but only a system of dilated calices in the kidney; this fact seemed to confirm further the faulty diagnosis.

On closer analysis of the extirpated kidney and especially of a similar case that was roentgenographed later on it was found that the incomplete

pyelographic picture of the dilated renal pelvis was in the first place not due to a stricture or muscular contraction of the collum calyces — as similar cases in the literature are often interpreted — but to the fact that the fluids commonly employed in pyelography (collargol, potassium iodide, sodium bromide) have in urine a tendency to sink to the bottom, and also to the fact that only very slowly (after hours) do they become evenly intermixed with the superincumbent urine or pus when the body is at rest.

In pyelography the employed contrast fluid settles like a sediment in the basin situated below the point of the catheter. In this basin the contrast fluid rises until it brims over and then flows into an adjacent basin. This tendency to »sedimentation» is an essential point to remember when interpreting pyelograms of dilated cavities that contain urine or pus prior to the pyelographing. Unfamiliarity with this fact has caused numerous faulty diagnoses and false conclusions.

This tendency to »sedimentation» of the pyelographic fluids does also entail some practical consequences in pyelography. If one wants to have the whole of the dilated renal pelvis well filled, one must turn the patient round once or twice in order to get the contrast fluid evenly intermixed with the urine or pus, so as to obtain an even contrast shadow. However, the contrast shadow will be faint if there is much fluid in the renal pelvis. If one wants to study particularly a certain part of the renal pelvis and to obtain sharp contours of it, e. g. the point of departure of the ureter, one ought to pyelograph and photograph the patient in a suitable position, in this instance in a more or less erect posture.

XI. T. Klason, Bergen: On the Horizontal Extent of the Heart[1]

There are cases where, by the metods hitherto employed, one is not able to say positively whether the heart is enlarged or not.

In such cases the enlargement may be found extending towards the back.

Up till now one has lacked methods for demonstrating an enlargement of this kind. The author describes a new method, by which one will be able to map out the extent of the heart.

In early cases of enlarged left ventricle the enlargement first takes place backwards. (Author-report.)

Discussion:

H. Laurell, Upsala: I consider, that the method elaborated by Dr. Klason to be eminently conducive to deepen and to improve the heart diagnosis, though by this method one is apparently not able to prove concavities but only convexities of the external pericardial surface. In cases where an extreme lung stasis makes it difficult to distinguish distinctly the posterior contours of the heart I recommend to let the patient swallow some contrast meal during the roentgenoscopy in oblique and transverse diameters; the oesophagus lies close against the pericardium and it frequently shows off beautifully not only the convexities but also the concavities of the posterior surface of the heart. Certain vitia give a typical picture of disfiguration and

[1] Will be published in extenso in Acta Radiologica.

dislocation of the distended oesophagus. This auxiliary method in the roentgenological diagnosis of the heart has already been employed for some years by Dr. Odqvist and myself at the Academic Hospital of Upsala.

2. T. Klason, Bergen: In examining fat cardial patients or patients with lung stasis I have derived considerable advantage from the »Potter Fluoroscopic Diapragm.» It is easy to handle and easy to place into position, and its efficacy in such cases is very obvious.

XII. G. Claessen, Reykjavik: The Roentgen Diagnosis of Echinococcal Tumours

The occurrence of echinococcosis: In Finland, on the south coast of the Baltic, in Russia, and in the Mediterranean countries. Rapidly increasing in the Argentine. Has previously been very common in Iceland but is now rapidly disappearing and is hardly ever found in young people, thanks to the hygienic and prophylactic arrangements made by the authorities. Sporadic occurrences in Scandinavia.

The echinococcal disease is a parasitic cyst of the Taenia echinococcus. Is often localized to the liver but can occur anywhere in the body.

The Roentgen examination is made partly for the purpose of differential diagnosis and partly in order to be able to determine satisfactorily the localization of the tumour. This is of the utmost importance when choosing the correct operation. In subphrenic echinococcosis a deformity of the superior surface of the liver may be proved roentgenologically, as well as an abnormal position and mobility of the shadows of the diaphragm and liver. Roentgenograms should be taken in both the anteroposterior and lateral positions. The roentgen examination can be of great importance for determining whether hemoptyses or coughed-up echinococcal elements originate from a primary pulmonary echinococcal tumour penetrated into the bronchi, or from a subphrenic echinococcosis of the liver that has progressed into the lung. Moreover, the lack of contrasts between liver tissue and echinococcal tumour makes the demonstration difficult, whereas an echinococcal tumour of the lung is seen distinctly.

If the echinococcal tumour is of old standing and calcified the roentgen plate exhibits shadows of calcifications which are of great help in diagnosing echinococcal tumours in the liver as well as in other organs.

Fistulae and cavities which often persist for years after the operation for echinococcal tumour can also be subjected to roentgen examination. After giving an injection of Beck's paste one may photograph the cavities and ascertain their size and position, and in the same way one may obtain information with regard to the direction and depth of the fistulae by taking roentgenograms, preferably in several positions, after having introduced a lead sound.

An echinococcal tumour in the stomach may produce a defect in the stomach shadow.

Echinococcal tumours of the bones may either appear as a cavity with regular edges, for instance in the sacrum, or may cause a spontaneous fracture of long bones owing to a destruction which in the roentgen plate does not differ from malignant metastatic tumours.

The paper was illustrated with 21 slides of roentgenograms of calcified and non-calcified, subphrenic, echinococcal tumours, pulmonary echinococcal tumours, partly primary and partly progressed from the liver, cavities from operations for echinococcal tumours, into which cavities BECK's paste had been injected or a lead sound introduced, calcified echinococcal tumours in the lateral ligaments of the uterus and in the stomach, and echinococcal tumours in bones.

XIII. S. Ström, Umeå: A Case of Pulmonary Cyst[1]

A benign pulmonary tumour accidentally discovered at a roentgenoscopic examination of the heart. The roentgen picture revealed in the right root a sharply defined shadow the size of a mandarinorange, with some small calcifications in its periphery. The diagnosis was neoplasm in the lung near the posterior thoracic wall. As it was considered that the possibility of an aneurism might be precluded on account of the clinical and roentgenologic findings, a test puncture was made. A yellowish-gray liquid mass was then obtained in the syringe, containing detritus and scanty cells but no bacteria. At the subsequent operation a cyst was found in the posterior portion of the lung just beneath the pleura. The wall of the cyst consisted of connective tissue, having here and there glandular formations. The cyst did not contain any tissue element characteristic of a dermoid cyst. The case is of interest as being a contribution to the roentgen picture of the rare benign pulmonary tumours.

XIV. S. N. Bakke, Christiania: Observations of the Movements of the Spinal Column

At the kind request of Professor FORSSELL I have made a series of roentgenological investigations of the movements of the spinal column at the Roentgen Institute of the Seraphimer Hospital.

The results I have arrived at are so widely different to those of other writers that I shall mention them briefly here.

First of all I want to meet the remark of Professor FR. MÜLLER (Zeitschr. f. Anatomie u. Entwicklungsgesch., May 1923) that the roentgenological method does not hold good in examinations of the mechanism of flexion of the spinal column. This is not by any means the case.

My investigations have further shown that the flexibility decreases and increases evenly from vertebra to vertebra along the whole of the spine. There are nowhere any inflexible parts interposed between the flexible, as E. H. WEBER asserts (Fr. Mechel's Arkiv, 1827). This obtains in regard to forward and backward bending as well as to side bending.

The cervical spine. Dorsal and ventral flexion.

The greatest power of motion is here found between the 5th and 6th cervical vertebrae, where the total motion averages 20.4°; 16.6° being dorsal flexion, and 3.8° ventral flexion. The total flexion of the cervical spine is 80.5°, 64.2° of which are dorsal flexion, and 16.3° ventral flexion. There is, thus, a predominant dorsal flexibility. R. FICK (Handbuch d. Anatomie und Mechanik d. Gelenke, 1911) states the total flexibility to be 180°. E. H. WEBER states 152.75°.

[1] Published in Acta Rad. vol. III, fasc. 1 pag. 60.

The thoracic spine.

The greatest flexibility is here found between the 1st and 2nd thoracic vertebrae, where the total flexibility is 9.8°, 4.8° being dorsal flexion, and 5 ventral flexion. In the next few vertebrae of the thoracic spine the total flexibility is about 5°, but here it is to be noted that the dorsal flexion in this portion of the spine is at a minimum. Thus, it is only 0.1° between the 4th and 5th thoracic vertebrae, whereas the ventral flexibility is correspondingly great, 4.9°. By and by as we proceed further down the thoracic spine, the power of dorsal flexion increases, but on the whole the ventral flexibility is greatest in this section of the spinal column. The total flexibility in the thoracic spine is 65.9°, 22° being dorsal flexion, and 45.9° ventral flexion. R. FICK states a total of 135°.

The lumbar spine.

The flexibility here reaches its maximum between the 4th and the 5th lumbar vertebrae, about 13°. But the flexibility is still greater beyond the lumbar spine, namely, between the 5th lumbar and the 1st sacral vertebrae, where the flexibility may amount to as much as 23°—24°, 21°—22° being dorsal flexion, and one or two degrees being ventral flexion. The total flexibility of the lumbar spine is 70.6°, 54.2° of dorsal flexion, and 16.4° of ventral flexion. The dorsal flexibility is, thus, predominant. R. FICK states 113°, and E. H. WEBER, 84°.

The total flexibility of the entire spinal column amounts to 219°, 140.4° of which are dorsal flexion, and 78.6° ventral flexion. The corresponding figures of R. FICK are 428°, 225°, and 203° respectively, and those of E. H. WEBER, 334°, 141.7°, and 192.3° respectively.

Lateral flexion.

Latterly, Professor FR. MÜLLER, of Tübingen, has been occupying himself with this subject. He has found that »die Wirbelsäule erscheint in einer Form die bisher nicht bekannt ist», namely, »eine schnurgerade verlaufende Reihe der Wirbelkörper von VI bis X thoracal Wirbel», where, thus, there is no lateral flexion.

I have now repeated Professor MÜLLER's experiments, only with this difference that I have been experimenting with living individuals, whereas MÜLLER has carried out his experiments on corpses. I have made the subject for my experiments perform a maximum side-bending, N. B. without this side-bending being associated with turning. In none of my subjects have I been able to find MÜLLER's »schnurgerade verlaufende Reihe».

Cervical spine. Here we find the greatest lateral flexibility from the 3rd to the 5th cervical vertebra, where it may be about 6°. The total lateral flexion of the entire cervical spine is about 23°.

Thoracic spine. The lateral flexibility is here about evenly distributed through the whole of this region, being about 2°—3°. The total flexion of the thoracic spine amounts to 30.6°.

Lumbar spine. The greatest lateral flexibility is here met with between the 2nd and 5th lumbar vertebrae, where it may amount to between 7° and 8°. Its total flexibility is 24.3°.

The total lateral flexion of the entire spinal column may vary between 75° and 80°. FR. MÜLLER has found 86°, in spite of the fact that he has found no flexion from the 6th to the 10th thoracic vertebrae.

R. FICK has found the total flexion to be 165° in a spinal column without any ribs attached to it.

(Author report.)

XV. A. Odencrantz, Ph. D., Stockholm: The Stereoscopic Measuring-Method and its Demands on the Instrument

Dr. Arvid Odencrantz gave first an account of the character of the roentgenogram as a central-perspective projection with accompanying deformation of the planes situated distant to the plate. He then described the general properties of the stereoscopic vision and its application to roentgenograms. The special advantages secured here are firstly that a plastic picture is procured and secondly that details which otherwise are only faintly appearing, now become distinct.

The procedure in making stereoscopic roentgenograms under different working conditions was described, and also the different arrangements for their examination. Full advantage can, however, not be derived from this method unless the roentgenogram is quite congruent to the real state of the part. The necessary condition for obtaining such a roentgenogram is that the view-points by means of suitable optical arrangements are brought into the same position in relation to the plates as the anticatodal focus had during the taking of the pictures; this implies partly a displacement of the tube between the two exposures — the base-line — and partly a change in its distance from the plate.

The speaker considered that this question had found its best solution in Pulfricks's Roentgenstereoscopic ocular.

Having a correct plastic picture of this kind, one can also make measurements on it. This can be done by adjusting marks, by direct measurements with compasses and square rule, or by »travelling marks» which are measurably displaced from one point in the picture to another.

Lastly, a description was given of the construction of an apparatus by means of which it is possible to secure the theoretically necessary and practically important accuracy, without complicating or hampering the single view.

Such an apparatus is of great advantage, for although there is no false *perspective* in the roentgenogram, there is very often a faulty view, and this may be not only hampering but even misleading in our work. It is therefore desirable that a correct stereoscopic working method be introduced into our Roentgen technic.

XVI. Gösta Runström, Stockholm: The Roentgen Picture of Fresh Subperiosteal Hemorrhages in Metatarsal Fractures [1]

In fractures of the metatarsal bones hemorrhages occur beneath the periosteum, in cases when this has not been damaged, and these hemorrhages appear in the Roentgen plate as thin spindle-shaped shadows.

[1] Published in Acta Rad. vol. III fasc. 1 pag. 42.

XVII. W. Morsing, Boden: Migrations of the Lime of the Thoracic Skeleton in Pulmonary Tuberculosis

(This paper has not been sent in to the Editor.)

Discussion:

G. Forssell, Stockholm: The speaker has not convinced me by the pictures demonstrated by him that the conclusions he has arrived at are correct. As regards first of all the rapid change in the shape of the upper thoracic aperture which he thinks he has observed, I only want to point out to him the simple fact that a very slight raising or lowering of the Roentgen tube, eventually in combination with a lateral displacement of the same, can very easily give a greatly altered projection picture of the thoracic aperture. It seems to me far more probable that the rapid change in the thoracic aperture observed by the speaker may rather be explained by a different projection in the different pictures than by a true deformity of the ribs.

Then, as regards the change in the density of the costal ends, one must consider what great changes may be simulated here, partly owing to unequally long exposures, partly owing to unequal distance to the plate and to the Roentgen tube, partly also to a different centering, and remember that a seemingly different density may easily be produced by a contrast effect, so that if the end of a rib is close to an uncalcified cartilage it *is seen* to be denser than when it is close to a calcified cartilage. The extensive conclusions arrived at by the speaker are, in my opinion, by no means justified by the pictures demonstrated by him. His arguments seem to me little convincing and his conclusions so unlikely that I would like to recommend the speaker to scrutinize once more the primary material and to revise his conclusions carefully.

2. The meeting at Svenska Läkarsällskapet

on the 19th of June 1923 from 9 a. m. to 1 p. m.

XVIII. E. Berven. Stockholm: Radiological Treatment of Chronic Tonsillitis [1]

1) The material comprises 154 patients, 150 of whom have been treated with radium and 4 with roentgen-rays.

2)a) The application on the palatine tonsils has been done by means of a tong-like instrument which admits of a minute focussing on the area of treatment as well as of a secure fixation.

b) The application on the pharyngeal tonsil has been done by means of an arrangement which well protects the soft palate and at the same time brings the radium preparation into direct contact with the surface to be treated.

c) Treatment at a distance has been given by means of the apparatus of Doctor LYSHOLM.

3)a) Very large, firm, fibrous tonsils of grown-up people have been treated with a dosage of about 96 m. gr. Ra. El. for 10—12 hours. The total filtration power of the filter corresponds to the filtration power of 2 m. m. lead. Distance: 4—5 m. m.

b) Large soft tonsils of grown-up people and children have been treated with a dosage of 96 m. gr., Ra. El. for $2^1/_2$—3 hours. Filter 0,35 m. m. gold + 0,30 m. m. platinum, corresponding to a filtration power of 1 m. m. lead. Distance: 1 m. m.

c) Small tonsils have been treated with a dosage of about 75 m. gr. Ra. El. for 3 hours by the same technic as in b.

d) The pharyngeal tonsil has been treated with a dosage of 50—96 m. gr. Ra. El. for 3 hours. Filter: 0,35 m. m. gold + 0,30 m. m. platinum. Distance: 1 m. m.

By the application of these dosages a comparatively powerful superficial effect is produced by the soft γ-radiation and the secondary β-radiation, at the same time as a deep effect is obtained by the hard γ-rays.

e) The distance-treatment has been given from the outside with 3—4 gr.-hours at a distance of 5 c. m. and with a total lead filter of 3 m. m.

f) Each tonsil has as a rule received one treatment with an interval of 4—5 weeks between the treatments of the tonsils.

4) The Roentgen treatment has been given in agreement in the main with the technic of WITHERBEE.

[1] Introductory address at the 3rd congress of the Northern Association for Medical Radiologi, Stockholm, 1923. Published in extenso in Acta Rad. vol. II fasc. 4—5.

5) The radium treatment has given the following results:
   a) The greatly enlarged tonsils have decreased to normal or to smaller size; also firm, fibrous and cicatrized tonsils have reacted by a distinct diminution in size. The fissured surface has become smoother and the deep crypts shallower. The contents of the crypts has diminished or disappeared.
   b) The attacks of angina, of which the patients have suffered frequently before the treatment, have ceased and the general condition of the patients has been improved. This latter fact applies especially to children.
   c) The secondary symptoms, which appear in connection with the local symptoms, have as a rule been greatly improved, when these secondary symptoms have not been distinctly chronic or have not reached a great development.
   d) The results of the treatment have so far been permanent during the time of observation.
   e) Of the radium-treated patients 135 have been relieved of their local symptoms; 2 have improved considerably; 3 still have troubles from their throat to the same extent as before; 3 who have only had partial treatment, have their throat troubles still left, too; 7 have abandoned treatment.

6)a) Out of 4 patients treated with Roentgen 1 has become symptomless, 2 very much improved, and 1 has abandoned treatment.
   b) A post-examination of 150 patients who havee been treated with Roentgen for tuberculous lymphoma, has furthr shown that the frequency of the angina has been unusually low in these patients after the treatment.

7) By the radiumtreatment a temporary change appears in the blood-picture corresponding to SIEGEL's bloodreaction of the first degree.

8) The microscopic examination shows that the diminution in size is due to a degeneration of lymphocytes and to an involution of the secondary follicles.

   The radium treatment brings on processes which clinically and anatomically resemble those through which the normal physiological involution of lymphoid tissue takes place.

9) The radium treatment given by the described technic has not caused any injuries.

Discussion:

1. IVAN SYK, Stockholm: The author has desired an opinion on his paper also by a practioner. Well, let me then say at once that I have read the author's perspicuous, clear and concise paper with very great pleasure and interest.

Few questions are so much in the order of the day of the oto-laryngologist, as just the question of the tonsil. The practical experience is, as the author quite correctly remarks, tending in the direction that the tonsil, being very often a seat or port of entry of a very great number of infections, shall be removed, since no actual disadvantage of its removal has been observed. It is therefore with the greatest interest we are informing ourselves on the paper of the author. Although the author points out on pag. 302 in his Introduction that the main point to him has been to discuss the question

from a radiologic standpoint, whether and to what extent it would be possible to treat a chronic tonsillitis, and not whether a radiologic treatment is preferable or not, it must axiomatically follow that if the treatment gives »a good clinical result», it must at once attract the interest of the practitioner. I shall now venture to critically examine Dr. BERVEN's paper, as far as a few short afternoon hours have allowed me to inform myself on it.

We find then first of all that the aim of the author is not to make the tonsil disappear completely. He is trying carefully to reach a stage where the tonsil no longer seems to exhibit any symptoms. He does not deny, however, that an increase may take place in young persons. Thus, we can not put the results obtained by the author's method on a level with the results that are obtained by tonsillectomy. It is rather a conservative procedure comparable with other conservative methods employed in the treatment of the tonsils, or possibly with tonsillotomy. It is of importance to set down this fact as the author's time of observation has necessarily been so short — how long it has been, is nowhere stated — that it is impossible from a practitioner's standpoint to draw even any relatively sure conclusions as to how the cases will eventually turn out.

I will also emphasize here that Dr. BERVEN's after-examinations have happened to coincide with a period very favourable to humanity as far as all kinds of oral infections are concerned. A unanimous opinion seems to be prevailing — also among old people — that there has been very little illness about in the last few years, and this obtains to no small degree, but rather perhaps to a very large extent, in regard to the so-called colds. Not only in regard to the frequency but also to the vitality of these colds. Formerly, one could hardly imagine such altogether really mild anginas, nasal catarrhs, etc., as those of the last few years. At the General Hospital for Children I have had ample opportunity for ascertaining this state, as is also witnessed by the accounts of the mothers when they come to have their children's tonsils removed, that »the child has certainly been almost well this winter but . . .»

It would have been interesting, had the author presented a tabula on the ages of the cases. The frequency of the tonsillar complaints do undoubtedly decrease as one gets older, from about the age of 4—7. In younger children the tonsillar complaints are much more common than is generally supposed. Plugs of exudate and small local abscesses are by no means uncommon in early childhood, they are on the contrary very common, perhaps mostly at the age of 2 or 3. I have not yet arranged the material I have collected at the General Hospital for Children. At all events, it is of a certain importance to know the age.

In young children one is also able to follow more easily the variations in the size of the ring of WALDEYER. It is not an altogether uncommon thing to find at one time a child with its tonsils so large as to leave hardly any room between them, and then after a month or two to find the same child with its tonsils almost disappeared between the faucial pillars. Great variations of size seem, thus, to occur even normally, if by normal one means the child's usual life with its now and again exacerbated catarrhs and cold-infections. It would have been interesting, if the author had stated whether the treatment has been given during the irritative stage or not. Even chronic tonsillitis has its periods of greater or smaller intensity.

I am not going to dwell much on the author's classification of his cases. I wonder, however, whether the lucidity would not have profited, if the author

had brought all the secondary symptoms together in one group, as I do not find the number of cases in the separate groups sufficiently great to allow even of an approximative opinion. I shall discuss the reason for this later on. However, with regard to Group X, the cases with tuberculous adenitis, I wish to remark that only 7 of 19 cases have exhibited other tuberculous symptoms. Chronically enlarged glands are by no means very uncommon in ordinary infections of the naso-pharyngeal or mouth regions. They seem very often to be driven away from the tonsils and may disappear very quickly if the tonsillitis is treated or allowed to heal by itself. I do not consider it justifiable to regard them a priori as being of a tuberculous nature. In group XVI the author has 3 cases, 2 of which have some small remains of their tonsils. Here it is, thus, not a question of tonsillectomy but of tonsillotomy.

If we now proceed to examine the tabula on pag. 322—323, where the author has arranged his cases in a very interesting manner, not least to the practioner, we find, if we only consider the total figures, that of 143 radium-treated cases 103 (94 + 4 + 5) have been completely and 40 (31 + 5 + 1 + 3) partially treated. By partial treatment Dr. BERVEN understands that only one tonsil has been subjected to radium treatment, thus a fairly limited amount of tonsillar tissue. It is important to emphasize this, as one would of course expect them to still have their troubles, though perhaps not so markedly. But what do we find? Why, not less than 31 out of the 40 partially treated patients have had their troubles removed, i. e. about three-fourths have been completely cured, one could say almost without the assistance of radium.

Let us make another arithmetical operation. Of the completely treated patients 9 still have their troubles, and the absolutely same number, i. e. 9, of the partially treated. This means that about 10 per cent have not got rid of their complaints in spite of a complete treatment, and that only about 22 per cent of the partially treated cases still have some troubles. The difference, i. e. 10 to 15 per cent, would thus be the gain obtained by this method of treatment!

Now one may ask: Is it possible that chance would have it, that three-fourths of the partially treated cases should have healed without further ado? To this we may answer: Not considering the time of observation which is still too short, and apart from the general good state of health and the favourable climate of the last winters, as well as from the fact that chance very often produces more wonderful results than we dare dream of, there is nevertheless an indication in Dr. BERVEN's paper that it is not altogether a mere contingency. For we read on page 327 line 8 from the top: »with a probe one can easily get into crypts 3 mm. deep», and on the same page line 12 from the top: »By squeezing the tonsil, quite a number of plugs may be pressed out from the crypts.» Here we have, thus, as far as I can see, the explanation why so many partially treated patients have got rid of their symptoms, in a number that is only 10 to 15 per cent, i. e. next to nothing, below the number of the completely treated cases. Dr. BERVEN has employed some very common and frequently very efficacious methods to make the symptoms disappear, viz. clearing out the lacunae and pressing out the plugs.

Referring to what I have said here, a practioner may be pardoned if he still remains sceptical as to the practical advantages of such an expensive and particular method as the one elaborated by Dr. BERVEN, which is not

altogether without its disadvantages, even though we may recognize its very great theoretic merits and its applicability under special conditions.

2. AGDA HOFVENDAHL, Stockholm: In connection with Dr. BERVEN's very interesting paper I think it might be of a certain interest to mention another method of treatment for the removal of the tonsils. Also this method is *bloodless*, viz. surgical diathermi, which method NAGELSCHMIDT of Berlin has been employing for the last two years, and by whom I have had the opportunity of studying this method.

After my return home I have performed only about 20 of these operations in my recently opened privat clinic, but the result in all cases has been good. Since I have also employed the usual surgical method and has performed a bloody operation on one side and a bloodless operation on the other (surgical diathermi), perhaps I may draw some comparisons, by your permission.

The advantages of the *bloody* operation are that it is quicker and that the reaction in the surrounding tissues is weaker.

The advantages of the surgical diathermi are: 1) no blood flows, 2) the field of operation can always be surveyed, 3) as the material often consists of patients suffering from some heart disease, and since these patients also are hyper-sensitive, it is an advantage that the interference can be made as slight as possible and can be interrupted by a pause at any moment, e. g. when the patient shows signs of fainting, 4) the faucial pillars can be more spared by the bloodless method.

The advantages of the surgical diathermi over the radium treatment seem, in my opinion, to be that 1) the field of operation can be strictly limited, which I suppose is hardly possible in the radium treatment, as adjacent and possibly healthy tonsillar tissue, e. g. on the base of the tongue, is also probably exposed to the effect of the radium, 2) the operation is of shorter duration: half an hour instead of three hours at best for each tonsil when radium is employed, which latter treatment further requires an interval of one month, whereas the operation on both sides can be performed at one sitting by the surgical diathermi, 3) the patients have been able to resume their work on the fifth day after having been treated by surgical diathermi.

3. E. BERVEN, Stockholm: The radiological treatment is conservative in the sense that the whole tonsillar tissue is not made to disappear. The macroscopical possibilities of infection through the pathologically changed tonsils are altered by the radiological treatment, that is to say, the loose mucous membrane and the deep crypts are restored to a more normal condition. The principle of the treatment is to restore an organ unfit for function to an organ which does not by its structure favour the origination of infections. By taking a sufficiently large radium dose, as for instance is done in malignant tumours of the tonsils, it is not at all impossible to atrophy the whole of the tonsillar tissue so completely as to show a perfect anatomical likeness to the picture obtained by tonsillectomy. After a tonsillectomy, normal adenoid tissue is left in great quantities in the pharynx, the volume of the tissue being certainly quite as large as the ectomized tonsils, without this tissue necessarily constituting a port of entry for fresh infections.

All the treated cases are chronic, with frequently recurring attacks of angina which have disappeared after the treatment. But this fact can hardly in this case be explained by especially favourable conditions of the weather.

In most cases the treatments have been given after the acute symptoms have disappeared and after the enlargements that are associated with these symptoms have diminished. Only in a few cases, in which tonsillectomy has been considered contraindicated on account of the subacute process, and in which the patient has suffered from this for a long time, the treatment has been given during a state of irritation. Here, too, favourable results have been obtained.

Dr. Syk is astonished that it has been possible to secure freedom from symptoms in partially treated patients, i. e. in patients who have had only one tonsil treated, and he considers that the favourable result is due only to a mechanical effect on the tonsil. I consider, on the contrary that this freedom from symptoms after partial treatment is a very interesting phenomenon and probably contributes towards the solution of the question of an active immunization by the radiological treatment of a focus of infection. It would, however, have taken me too far to enter fully into this important question, but I hope to adduce proofs in a future paper of my views in this question.

With regard to Dr. Hofvendahl's surgical diathermi, it attracts but little interest in this connection. I only wish to call attention to the risk of late bleeding which is the reason why the patient must be kept under observation until the wound has cleared up and become covered with granulations. Not until the fifth day the patient can resume his work, whereas the working power is never reduced by the radiological treatment.

4. Gösta Forssell, Stockholm: To me who have had the opportunity of following some of Dr. Berven's cases, there is no doubt whatever but that the almost constant and typical change in the tonsils has been produced by the treatment. By his investigations and his technique of treatment Dr. Berven has, in my opinion, materially advanced the radiotherapy. Personally I should, however, consider it a happy thing, if in further attempts to develop the technique one would try to employ doses which do not cause a superficial necrosis. No injuries have so far occurred, it is true, but the time for observation has as yet been to short to allow of an absolute certainty. We know of course that, after skin radiation, injuries may appear several years after the treatment has been finished. For this reason, my ruling principle in treating benign diseases has for many years been to try avoiding doses that produce an inflammatory change in the skin. From the experience of Dr. Berven and others we know that it is quite feasible to obtain an atrophy of the tonsil without injuring the mucous membrane. But for this reason one need not prolong the time of treatment, if, for instance, one increases the amount of radium, and eventually also the protection towards the surroundings, at the same time as one increases the distance to the mucous membrane or increases the filter. I should also like to make an objection to Dr. Berven's view as to the cause of the bactericidal effect of the radiation. He wants to explain it in this way, that the lacunae on the surface of the tonsil have been diminished, whereby the drainage has been improved. It seems more likely, though, as if we were dealing with an experience known from the radium treatment of another, tuberculous, tissue, viz. that the breaking down products in the radium-treated tuberculous tissue have a bactericidal effect, and eventually cause the production of an antitoxin, and that the explanation, thus, is to be found in a biological change within the tissue itself.

XIX. A. Reyn, Copenhagen: Light- and Roentgen Treatment of Tuberculous Lymphomata [1]

During the period 1910—1920 553 cases of tuberculous lymphoma have been treated at the Finsen Institute, partly by Roentgen and partly by light-baths. Nearly all the fistulous forms have furthermore been treated by concentrated chemical electric-arc light (Finsen). The material includes a number of very severe cases of long duration.

The results prove that the light in the form of artificial chemical light-baths (nearly all the patients have been treated by carbon-arc-light baths, which the writer considers the best) gives far better results than the Roentgen treatment, as 98 % or nearly all patients treated by light-baths have become cured, whereas the Roentgen treatment alone cured only 40 %.

It has been pointed out how dangerous the Roengen-treatment may be, owing to its very injurious effect on the skin, as the Roentgen-rays can produce atrophy as well as vascular dilatation of the skin when given in such doses that are employed and recommended by many medical writers; very large doses can produce serious Roentgen burns. The writer calls attention to the fact that one has not taken this danger into sufficient consideration, whereas in the treatment of tuberculous lymphomata, hard filtered rays are being employed. The reason for this is to a great extent to be sought in the fact that these changes often appear months and even years after the treatment has been concluded.

The writer emphasizes how important it is to continue to observe the patients after the cessation of their treatment, as the tuberculous lymphomata have a tendency to recur, and the results at the discharge of the patients are therefore of but slight value. The writer himself keeps his patients under observation for many years. In this manner, 408 of the cured cases have been observed for 2 years or more, and 213, for 4 years or more.

The light has no injurious effect, on the contrary, it is beneficial to the whole organism, which revives. The patients are refreshed both physically and mentally by the light-bath.

The writer considers that the modern treatment of tuberculous glands should be a combination of all known methods, light, operation and Roentgen rays, the last-mentioned, however, to be given in such small doses that one may be quite certain not to harm the patient.

The concentrated chemical carbon-arc light (Finsen treatment) is a very valuable aid to the local treatment of the fistulous forms, the healing of the fistulae being both quicker and more certain.

The writer lays stress emphatically on the great importance of building seaside sanatoria for these patients, where great benefit can be derived from the sun and the fresh air. These sanatoria should be fitted out with artificial chemical light-baths to take the place of the sun-baths which, as we know, can only be utilized for a comparatively short period of the year here in Scandinavia.

These sanatoria will also be very valuable from the point of view that infectious fistulous cases can be isolated there. In Denmark, we have such sanatoria for children but not for adults.

[1] Will be published in extenso in Acta Rad.

The writer shows how important it is that individuals suspected of suffering from tuberculosis are sent into the country in the summer and given sun-baths, and eventually artificial ligh-baths in the winter months, and he also points out the importance of sending children who are manifestly suffering from tuberculous glands to a sea-side sanatorium.

The writer's material comprises 68 % of adults, which fact enchances the value of the percentage of cured cases, as the various forms of surgical tuberculosis are much easier to cure in children than in adults.

Some slides of patients taken before and after treatment were demonstrated.

(Author-report.)

XX. Gösta Runström, Stockholm: The Results of Roentgen Treatment of Tuberculous Lymphomata at the Seraphimer Hospital, Stockholm [1]

An analysis of the cases of tuberculous glands in the neck which have been treated with Roentgen light in the Roentgen Department of the Seraphimer Hospital during the period 1911—1921.

145 cases. All but one have been cured. Slight skin changes in 28 cases, 20 of which had telangiectasia. Five of these 20 have been post-treated after a non-prevalent method and with larger doses. Skin changes have generally appeared in cases which have had fistulae and tuberculous skin lesions. The skin changes have been most common in patients over 15 years of age. The skin changes can be reduced in number by choosing smaller dosages and by preventing the occurrence of persistent fistulae and in some cases also by using a harder filtration, 0,5 millimeters of copper. In no cases have there been any serious skin lesions.

Discussion to lectures XIX and XX:

1. Gösta Forssell, Stockholm: The Roentgen injuries in patients who have been treated for tuberculous lymphomata at the Finsen Institute and have been demonstrated here by Doctor Reyn, have all been caused by doses that we do not here consider suitable, nor do we employ them. As far as I have been able to understand the matter, all the cases with severe injuries which have been shown here, have received doses of at least 10 H, in some cases as much as 15 à 20 H with a filter of 3 à 5 millimeters of Aluminium. With such doses the risk of causing injuries must be great. On the basis of such a technique one is not justified in criticizing the Roentgen treatment of lymphomata in general, nor to make a fair comparison between it and another method of treatment. But we ought, on the other hand, to be very grateful to Doctor Reyn for the criticism of the large doses in Roentgen treatment of lymphoma, which his paper contains. I am convinced, just as Doctor Reyn is, that the ordinary light-treatment can have a very favourable effect on the tuberculous lymphomata and I should think that a combined Roentgen and light-treatment would be the best method. When Doctor Reyn obtains a cure in 98 % of those cases where only light-treatment has been employed, but not even 50 % in the case of lymphoma where only

[1] Will be published in extenso in Acta Rad.

Roentgen treatment has been resorted to, then I must be extremely doubtful whether a comparable material has been to hand in both cases.

With a cautious technique of treatment one can obtain good results with a comparatively small risk of skin lesions. We give in each series of treatment altogether 1/2 H. E. D. at the most, dividing the doses in a number of smaller doses. The treatment is given to a large extent in combination with small surgical operations. When skin lesions occur after comparatively small doses, one must generally suppose that a wrong dosage has been delivered unintentionally, though there is scarcely any doubt but that one may come across patients with an abnormal sensibility. Personally I am convinced that a previous luetic infection or eventually a hereditary syphilis, which has produced a weakness of the vascular system, involves an enhanced risk of late-appearing lesions. I know of one case where a young man affected with hereditary syphilis, who had been treated for eczema at the back of his knee-joint with a dose that did not cause any visible skin reaction, six years later got a deep necrotic wound in the treated area. In three more cases of late Roentgen necrosis, which have come under my notice, there has been a luetic infection. There is thus every reason to pay particular attention to this matter. I have more and more become positively convinced that the Roentgen therapy must be placed entirely in the hands of a competent radiologist. The risks have become greater in proportion as the efficiency of the apparatuses have become increased. Accidents can not be entirely avoided as yet, not even with the most careful technique in the hands of a skilful radiologist, but the severe injuries, which have come under my notice from places where Roentgen treatment is practised without efficient previous training, have convinced me, that the time has come for putting as soon as possible and with all energy a definite stop to the dilettant use of the highly different means of the Roentgen light.

2. H. Waldenström, Stockholm: I believe that the light treatment is an excellent aid to us in our treatment of the surgical tuberculosis, though not to such an obvious extent that we can prove statistically that the tuberculous focus heals quicker and better by the light treatment. I except, however, the superficial tuberculosis, where the good effect can actually be shown. But the good effect of the light treatment in improving the general condition can, on the other hand, be shown, in the increase in the weight of the body.

3. S. A. Heyerdahl, Christiania: Since 1913 I have treated tuberculous lymphomata at the Rikshospital in Chistiania, partly with arc-light baths alone, partly with arc-light and Roentgen rays, and partly exclusively with Roentgen rays.

I believe Doctor Reyn is mainly right in his view that these methods of treatment combined, as a rule, give the best results. But the fact is that the arc-light treatment is a very long treatment and is, further, not so easy to arrange everywhere, whereas the Roentgen treatment is usually more accessible and takes less time.

With regard to the technique of the Roentgen treatment I will make the same remarks as Professor Forssell. One ought to avoid the large doses which are not the correct doses for the tuberculous lymphomata nor for tuberculous complaints taken as a whole.

Employing soft rays with a 3 millimeters Al filter and about 2 H units is the method that has given the best results at the Rikshospital. — By this method one does not get skin atrophy, telengiectasis or other late injuries of the skin.

In 1922 we tried deep therapy for a short period, with 45 centimeters spark gap, 5 millimeters zinc filter and full skin unit dose, but we had to give up this method, as it gave bad results, slow reduction of the glandular tumours and at the same time a peculiar infiltration into skin and subcutis, resembling the indurative oedema that is produced in the skin by the large deep doses.

At the Rikshospital we have, as a rule, treated tuberculous lymphomata in adults, who have not exhibited other signs of tuberculosis, with roentgen rays only, while children with glandular tuberculosis and adults with signs of tuberculosis in other organs have been given arc-light in combination with Roentgen treatment.

I wish to point out an important fact that was not mentioned in Doctor REYN's address. That is the good effect of the arc-light baths on the general condition of the tuberculous individuals. The local glandular tuberculosis is, as we know, generally only a local symptom in a tuberculous patient. It is not only the local symptom that has to be treated, but the tuberculous patient.

Concerning the results of the Roentgen treatment in patients with tuberculous lymphoma, these have been very good at the Rikshospital in Christiania and far better than those Doctor REYN has obtained by his large doses. Most of the patients have consulted a surgeon before and been under observation for long periods. By a combination of Roentgen treatment and puncture of the abscess one obtains a cure in the majority of uncomplicated cases.

4. C. FÜRST, Mâlilla: I only wish to put a question to the Radiologist gentlemen: What is the significance of the combined arc-light and Roentgen treatments with regard to the skin atrophy? When I was studying with Doctor REYN, he employed a local concentrated Finsen treatment immediately after Roentgen treatment in order, as he said, »to prevent the atrophy». But, at my visit to Wintz I was told that they had often seen »scorching» in patients who, after having been treated by the usual Roentgen doses of the clinic, had exposed themselves to strong sun light, and vice versa. HOLZKNECHT considered this condition not improbable. For this reason I always cover the part that is being Roentgen treated, when the patient is at the same time given universal arc-light bath. Is this necessary?

5. A. REYN, Copenhagen: First of all I would thank those members who have taken part in the discussion. It is, of course, impossible for me to reply to everything in the short time alloted me, and much of what has been said and asked is to be found in my paper which, later on, will be published in the Acta Radiologica.

To Professor FORSSELL I would like to say that we are of one opinion in the main and that the doses employed ought to be very small, and as you will remember I just said that »unfortunately» I had allowed myself to be misled into increasing the doses but I have now abandoned these somewhat larger doses. When Professor FORSSELL says that I have used too strong doses on the patient with roentgenological changes, of whom I have

demonstrated photographs, he is, of course, right, but the doses were not larger than those recommended by many medical writers. And I want to point out that, as I have said, I have seen roentgenological changes produced by far smaller doses, e. g. 5 H filtered through 3 millimeters of aluminium, when the dose has been repeated 5 times at intervals of 2 months, and I do not think we should be too sure that not the small doses will produce roentgenological changes. They may appear years after the conclusion of the treatment and for that reason we cannot be sufficiently careful. Unfortunately I have only had time to enter quite summarily into this now, otherwise it would have been clear that FORSSELL and I quite agree with each other. I have emphasized that one should combine all the different methods of treatment at our disposal, both Roentgen and light-treatment and operation.

To Doctor WALDENSTÖM I want to say that I fail to understand his remarks that it is not easy to judge how beneficient the light-treatment is, for the material produced by Doctor ERNST from the Finsen Institute concerning the electric arc light treatment of surgical tuberculosis constitutes a rather indisputable proof of that fact, which is also borne out by the material demonstrated by me to-day. From the very first I was fully aware that it was necessary for me to attach a surgeon to the Institute, because, if I had myself produced the material, people would only have said that I was of course not able to judge whether equally good results would not be secured by the common conservative or other methods. For this reason, then, it was left to Doctor ERNST, who was skilled in the treatment of surgical tuberculosis, to direct my treatment, as he was able to judge whether the results were satisfactory or not. His judgement of the method has been decisive, and there can be no doubt but that the electric arc light plays a highly important role in the treatment of surgical tuberculosis.

Doctor HEYERDAHL emphasized that one must not regard the lymphomata as being a purely local disease, but remember that a great many of these patients may be regarded as tuberculous individuals, and their glands as a local manifestation of that condition. I quite agree with Doctor HEYERDAHL and in my paper I have laid very great stress on that point. The light-baths are consequently of an extra-ordinarily great value, as by their means we produce a general effect on the whole organism. In one respect I go still further, as I consider that we have to give individuals, who are suspected of suffering from tuberculosis, light-baths, either sun-light or electric arc light, before they exhibit actual symptoms of tuberculosis, because hereby one will certainly reduce the frequency of tuberculosis. I think a prophylactic treatment of this kind is of the very greatest value.

Professor FORSSELL asked whether none of the patients who had exhibited roentgenological changes, had had lues. That is not very probable, as we take a WASSERMANN test of all our patients suffering from tuberculosis, and none of them has had a positive reaction; but of course the possibility is not altogether precluded.

Doctor FÜRST asked if the light did not increase the reaction of the Roentgen rays.

There is hardly any doubt but that is does. The two reactions increase each other. But the light-reaction disappears without leaving any trace behind, whereas the Roentgen reaction, which, as we know, produces a reduced vitality of the tissues, increases, and roentgenological changes can

then occur more easily. Doctor FÜRST is therefore quite right in stating that the Roentgen treated portions should be covered during the light-bath. It is quite a different thing that the local Finsen treatment counter-acts the harmful effects of the Roentgen rays, e. g. in the case of treating a lupus vulgaris. In that case it is well to treat the lupous portions by concentrated chemical electric arc light immediately after the Roentgen irradiation, which, on the whole, should not be given in large doses in lues. In this way I think one can counter-act the injurious effect of the Roentgen rays, without a loss arising from their beneficial effect.

There are still many things that I should have liked to reply to and to speak about, but time does unfortunately not permit it.

6. H. WALDENSTRÖM, Stockholm: I am not adverse to the arc-light treatment, quite the contrary, which is proved by the fact that in my department of the St. Göran Hospital a new arc-light room is now being built to enable us to continue this treatment to a still greater extent than before. I believe in the treatment, but, contrary to Doctor REYN, I am of the opinion that one can not *statistically* prove better results by this method than by any other. More critical investigations are necessary.

7. G. FORSSELL, Stockholm: The treatment with quarz-light is nowadays »modern». All over the world the quartz-light treatment is practised to a very large extent both at hospitals and by private practitioners, without the attending physician in most cases having any very great knowledge of light therapy, indeed, even unqualified laymen consider themselves competent to administer such a treatment.

The risks in lighttreatment are, of course, not to be compared with the risks in Roentgen treatment, but even the light may cause obvious injuries through a clumsy manner of proceeding, and it is of course quite erroneous to think that the artificial light is good simply for all complaints.

Denmark, the pioneer country in the field of the light therapy, and Norway have the great advantage in possessing scientifically conducted institutions for the study of the light therapy. The light-therapy in Sweden is still in an early stage, but I hope that we shall progress towards a scientific development of the light-therapy also in our country.

8. A. REYN, Copenhagen: There are a great many things I have not had an opportunity of speaking about and which I shall not be able to refer to now owing to the shortness of the time allotted to me, but I would like to make the following remarks.

To Professor FORSSELL I will say that, as we request the Roentgen treatment to be administered only by skilled people, it becomes necessary for ourselves to be very careful not to bring about any bad effects. I contend that many doses recommended by various roentgenologists are quite unjustifiable, and we must ourselves call attention to this, as otherwise we would do the roentgenology a great deal of harm; and I have therefore pointed out how harmful the Roentgen treatment may be if one is not very careful. I consider, like FORSSELL does, that we should combine all methods. We can first try the Roentgen treatment alone, and if it does not give any result quickly, then light-baths may be employed. In cases of lymphomata with a single isolated gland I think it is well sometimes to extirpate the

entire gland. If the patient has time, we may give him light-baths afterwards; this is done in consideration of what Dr. HEYERDAHL has pointed out, that we must regard the patients as tuberculous individuals.

FORSSELL is, of course, quite right in saying that it is very unlucky the way the quartz-lamp is advertised and gains ground in many places, as this will give bad results, first of all because it produces a far smaller effect than the electric arc light, and secondly because it is employed uncritically by people who have no proper knowledge of light-therapy. Dr. WALDENSTRÖM says that my percentage of cases cured by light-baths is remarkably high, and he thinks that this is due to the disease in several cases having disappeared by itself. Furthermore he says that the patient with the large lymphomata, whose photograph I showed on the screen, was a case where we all of us often see the disease disappear with the aid of poultices (compression). To this I would remark that, as you will no doubt remember, I have pointed out that I have not taken any patients for treatment when their lymphoma has been of but short duration, and the patient referred to by Dr. Waldenström had had lymphomata for five years, and when this disease has lasted so long without any sign of improvement, there is hardly any reason to suppose that the glands would disappear by themselves; and all cases shown by me on the screen are of a similar kind.

With regard to the patients we have treated for surgical tuberculosis, I wish to point out that most of them had been treated for several years, both conservatively and operatively, and therefore it is undoubtedly the light-bath alone that has cured them. When Dr. WALDENSTRÖM says that a treatment, by which one gets 19 % unimproved cases, is of no value, I do not agree with him on that point. What I wished particularly to point out was that we should combine all the different methods at our disposal, and that is also very clearly stated in my paper, which will appear in the Acta Radiologica.

XXI. Carl Sonne, Copenhagen: The Effect of the Light-bath in Rachitis

In the last two or three years reports have appeared, particularly from Germany and America, as to the brilliant effect obtained by means of the light-bath in children suffering from rickets. As it has now been proved that it is a comparatively easy thing to produce rickets in various animals, especially in young rats, by means af a suitable diet, the effect of the light on such young rats has been studied in America (HESS and UNGER). Similar investigations have been instituted in the laboratory of the Finsen Institute in Copenhagen by P. SCHULTZER and CARL SONNE. The excellent protective effect of the light-bath in rickets has been verified. Even one minute's irradiation every day with a mercury-quartz lamp (Höhensonne) has a great protective effect. The rachitic animals have a smaller amount of acid-soluble phosphorus in their blood serum than normal, but by the irradiation the amount of phosphorus is raized to the normal. It is the ultraviolet rays from 400 $\mu\mu$ to about 280 $\mu\mu$ that have been active; the luminous rays alone have no demonstrable effect. The outmost ultraviolet rays, from 280 $\mu\mu$ and upwards, have also been dispensable.

It is very probable that the action of the light-bath with regard to rickets is quite different to what it is with regard to surgical tuberculosis.

Discussion:

1. A. Reyn, Copenhagen: I want to thank Dr. Sonne for his exceedingly interesting paper. When Dr. Sonne says that we do not know which rays are active in tuberculosis, I will only remark that the best results are, as we know, obtained in the mountains and at the sea-side, when treating surgical tuberculosis with sun-light. From this fact I think we might infer that it is not the ultra-violet rays with short wave-lengths that are the best ones, for these are absorbed even by thin layers of the atmosphere, but rather the ultra-violet rays with long wave-lengths, for the rays with the shortest wave-lengths are not to be found in low-lying levels, neither inland nor at the surface of the sea.

2. Gösta Forssell, Stockholm: I must congratulate the speaker on the extremely interesting results which he has set forth to us here. One must really say that his experiments strike one as being a convincing proof of the effect of the light upon the pathological process in the experimental rachitis. It would, however, be very interesting to hear whether our colleagues at the Finsen Institute, who are in possession of the largest collective experience in this subject, think they are able on the basis of their own or other people's experience to give a plausible explanation of the therapeutic mechanism in the general light-treatment. I have not been able to find in the literature at my disposal any theory capable of giving an acceptable explanation of the obvious general effect produced by the light in spite of its low penetration.

3. C. Sonne, Copenhagen: To Professor Forssell I want to say that as regards the light we know very little of its mode of action, and especially in rickets; one might suggest the possibility of its influence on a ferment or the like, and in that case probably in the very superficial cells of the skin, causing a change in the phosphorus metabolism. But this is mere speculation.

In answering Dr. Reyn I should like to accentuate, that whenever an increase of the ultra-violet rays in the sun-light is found, a greater amount of the luminous rays is also sure to follow. For this reason there are obvious difficulties in concluding which rays are the active ones when the base for conclusion is only the different action of the sun-bath in different places.

4. G. Forssell, Stockholm: *Would it not be possible to explain the general effect of the light as being a result of the photo-electric effect, being thus analogous to the effect of the Roentgen light*?

It is, as we know, a generally accepted view of to-day that the essential effect in Roentgen irradiation is produced by the secondary β-rays, i. e. by the *electron irradiation* produced by the Roentgen rays. It is a well-known fact of course that an electron irradiation is started from a surface by the effect of light on that same surface. This irradiation constitues the so-called "radio-electrical effect". This irradiation does very likely *produce a*

change of the electrical condition of the body, not only on the surface but also in subjacent layers, this change being probably the more marked the larger the surfaces of the body are which are exposed to the irradiation. Is it not conceivable that the general influence on the chemical processes in the body as well as on its condition in general might be explained by such an effect? If there be any ground for this hypothesis, one might possibly be able to influence the effect of the irradiation by varying the electric charge of the body and the conductive power of the circumambient air.

From this point of view it is perhaps possible to a certain extent to explain the effect of light under different climatical conditions.

5. A. Reyn, Copenhagen: It may be that I have not expressed myself quite clearly, but in the main I agree with Dr. Sonne. In fact, I believe that all rays, except those with the shortest wave-lengths, are active. The surface of the sea reflects the light, as we know, but probably it absorbs some of the ultra-violet rays.

XXII. S. A. Heyerdahl, Christiania: Some Further Experiences of the Treatment of Malignant Tumours with Radium Needles

At the last meeting of our Association in Copenhagen 1921 I gave a short report on the results we had then obtained at the Rikshospital in Christiania in the treatment of malignant tumours with radium enclosed in thin metal needles (vide Acta Radiologica vol. I, fasc. 3).

Of the six patients, the clinical history and treatment of whom I described in Copenhagen, one is dead. This patient had an inoperable and very advanced cancer of the jaw (Case I, O. P.), the tumour having encroached upon the cheek and chin. He died from metastases about a year later. The remaining five patients are living and are well and strong.

The two years' experience we now have, has confirmed our first impression that the needle treatment is a real progress in the radium therapy.

We have found the greatest effect of the radium needles in cancer of the skin, cancer of the lip, and malignant tumours of the cavity of the mouth.

The needle treatment is often combined with an external application of radium tubes with highly filtered rays (1—2 mm. lead filter).

The radium needles introduced into the tumour are removed after 10 to 20 hours, depending upon the nature and size of the tumour.

In ulcerating skin cancer we have frequently applied the radium needle wrapped up in xeroform gauze directly on the ulcerating surface (4 hours of application) and at the same time employed radium tubes with highly filtered rays on the infiltrated edge of the tumour (10 to 20 hours of application).

When introducing the radium needles into tumours, one should especially avoid doing it through ulcerated surfaces, except in such cases where there is free drainage.

In our radium treatment of epitheliomata of the skin that have attacked the tarsal cartilages, the cartilages of the nose and ear, we have obtained with radium needles much better results than before.

Dr. HEYERDAHL instanced six cases of epithelioma of the skin which he demonstrated with lantern slides, and which had been treated with radium needles with a curative effect. A previous external application of radium tubes with highly filtrated rays had had no effect in one or two cases. All the cases were old and advanced and the subjacent cartilage (tarsal cartilages, and the cartilages of the nose and ear) was in most cases affected.

Dr. HEYERDAHL also described 3 cases of sarcoma (one case of sarcoma of the ear, one case of sarcoma of the superior maxilla, and one case of sarcoma of the tonsil) which had been cured by the treatment with radium needles.

XXIII. S. A. Heyerdahl, Christiania: A Case of Paget's Disease Cured by Roentgen and Radium Rays

In January 1921 a 52 years old married woman was operated upon for mammary cancer. The operation wound became infected and in that connection a skin affection set in which clinically and anatomo-pathologically was interpreted as PAGET's disease. One year after the operation the affection had extended over a large portion of the front of the left chest, over the axilla and the adjacent region of the back of the left chest. A combined Roentgen and radium treatment[1] (Roentgen rays delivered to the front and back of the thorax, and radium in the axilla), made the affection disappear entirely in about three months.

She has afterwards been quite well. She was examined the last time in February 1924.

XXIV. G. A. Wetterstrand, Helsingfors: A Contribution to the Question of Roentgen Treatment in Syringo-Myelitis

In consequence of the relatively favourable experience the speaker has had of the Roentgen treatment in syringo-myelitis and in view of the absolutely bad prognosis of said complaint, he considers that the therapy above mentioned ought positively to be employed very much more than has been the case up till now. In cases that have been diagnosed at an early stage and where the anatomo-pathological changes are therefore relatively small, one has reason to expect a marked improvement, a stationary condition may be achieved in the more advanced cases.

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[1] *Roentgen treatment:* 45 centimeters spark-gap, 1/2 millimeter of zink filter, jone-tube, 50 centimeters skin focus distance, 2 milliampères, three hours exposure to the front of the chest and three hours exposure to the back.

Radium treatment: 10 centigrams of radium (radiumbromide) in tubes, 1 millimeter of lead filter in the axilla. 20 hours exposure, which is repeated once after an interval of one month.

XXV. G. Forssell, Stockholm: Barium Porcelain; A New Protective Material against the Roentgen Rays

As a protection against the rays one has hitherto placed the Roentgen tubes in hoods of lead glass, lead or lead rubber of different compositions. The lead glass, however, has two disadvantages, firstly that one has so far not been able to produce a lead glass that affords a quite efficient protection, and secondly that it is difficult to mould in any but very simple forms. The lead rubber gets dry very easily and cracks readily, and, moreover, it is difficult to make quite compact. The lead, finally, is a conductor of the electric current, and protection hoods of lead must consequently be made very wide, and thus they become very heavy and bulky.

On the initiative of the speaker Mr. Axel Odelberg C. E. at the Gustafsberg China Factory has composed a porcelain mass holding a high percentage of barium sulphate and absorbing Roentgen light in a very high degree. Two and a half centimeters of this mass absorbs just as much Roentgen light as three millimeters of lead. From this barium porcelain it is feasible to produce protective hoods that will completely enclose the Roentgen tubes and at the same time afford a fully efficient protection. Protective hoods of various patterns are now being manufactured at the Gustafsberg China Factory, and also various patterns of tube diaphragms to be employed in the treatment, as well as porcelain slabs for covering protection walls.

XXVI. P. Amundsen. Christiania: Blood Anomalies in Radiologists and in Persons Employed in Radiological Service [1]

The blood picture of radiologists and their personnel always shows a deviation from the normal.

The absolute number of white blood cells is often less than the normal average. The change is most marked in the ratio of the polynuclear leukocytes and the lymphocytes: a reduced percentage of leukocytes and an increased presentage of lymphocytes (relative lymphocytosis). The percentage of haemoglobin has nearly always been found normal. The effect on the blood is observed already after one or two months of radiological work and it can also be traced in the maid-servants of the radium department. The blood picture is distinctly improved after a long leave of absence. Improved means of protection are recommended so as to lessen the risk always incurred by all radiological workers. Blood examinations of the personnel belonging to the Roentgen and radium institute of the Rikshospital, carried out a long time after the protective arrangements had been revised and improved, showed a considerable improvement of the blood picture of the permanent personnel.

(Author-report.)

[1] Published in Acta Rad. vol. III fasc. I pag. 1.

Discussion:

1. A. WESTMAN, Umeå: The results of the examinations that have been made in Stockholm on the staff occupied with ray therapy coincide in the main with those presented by Doctor AMUNDSEN. Firstly, we have made examinations of doctors who for some considerable time have been occupied with radiology, secondly, on a number of Roentgen and radium nurses, and lastly, on nurse's apprentices who for a short period have been in training in Radiumhemmet. Concerning first of all the doctors, one finds no change in the picture of their red blood corpuscles. On an average I have found from 5 to 5,5 millions of red blood corpuscles and a haemoglobin value of 80 per cent. On the other hand, there is a distinct change as far as the white corpuscles are concerned, the average number of which have been found to be about 4,800, with a clear displacement between the polynuclear and mononuclear cells. On an average I have found 50,4 per cent neutrophils 40,5 per cent lymhocytes, 6 per cent large mononuclears, 2,9 per cent eosinophils, and 2 per cent basophils. I have not met with any extremely low values. The lowest one has been 3,150 white corpuscles with 49 per cent mononuclear cells. No abnormal cells forms have been found.

The blood picture of the nurses who for some considerable time have been working in radiological departments, shows about the same changes that were found in the doctors, although less pronounced. The mean value of the red blood corpuscles has been found to be about 4,800,000, the haemoglobin about 75 per cent, and the number of white blood corpuscles about 5,400, of which 61 per cent were neutrophils, 31,9 per cent lympocytes, 5,1 per cent mononuclears, 1,8 per cent eosinophils, and 2 per cent basophils. The lowest number of white blood corpuscles has been 3,800, with 49 per cent mononuclear cell.

The work at Radiumhemmet has been arranged so that the course of training of the apprentices has as a rule lasted four months. During this time the apprentices have been more exposed to the rays than the rest of the staff, as they have had to do the radium packing and have had to stay in the Roentgen laboratories in the course of the work more than the regular nurses. In spite of this fact, there has been no distinct change in their blood picture, not taking into account a slight decrease in the number of the red blood corpuscles and haemoglobin value.

2. S. A. HEYERDAHL, Christiania: Personally I am very glad that Doctor AMUNDSEN has taken up this subject for further discussion and that he has made these blood examinations of our Roentgen staff at the Rikshospital. It is of great importance to a manager of a radiological institute that such examinations are made at regular intervals. As regards the development of leukæmia owing to a lengthy exposure to Roentgen rays, I have always been sceptical as to this being a cause of the leukæmia. However, I will just mention that one of my Roentgen nurses at my private institute died from myelogenetic leukoæmia after having worked six years at the institute. Personally I consider this a coincidence.

3. F. VON BERGEN, Gothenburg: Corroborated the experiences of the preceding speakers. He had found lymphocyte values as high as 60 per cent. One case with 56 per cent lymphocytes after four months Roentgen

work can no doubt be associated with a closed slight tuberculosis. Two months work in a therapeutic department behind Kempe-Lorey walls had reduced the number of lymphocytes from 40 à 45 per cent to 30 à 35 per cent.

XXVII. Leif Arentzen and Carl Krebs, Aarhus: Investigation into the Biological Action of Roentgen Rays.

These investigations were undertaken with Victoria peas (pisum sativum) cultivated on blocks of plastea as devised by Professor W. JOHANNSEN.

The tip of the root was exposed to Roentgen rays and afterwards measured, up to four days after exposure.

Results: After carrying out more than 70.000 measurements we have succeeded in making a reliable determination of the inciting dose of unfiltered, aluminiumfiltered and copperfiltered Roentgen rays, respectively.

It appears that aluminiumfiltered Roentgen rays have considerably less action on the peas than unfiltered or copperfiltered Roentgen rays.

3. The meeting at Radiumhemmet

on the 19th of June 1923 from 2 to 5 p. m.

XXVIII. Nils Westermark: The Electro-Coagulation in Cancer Mammae

In a short history the author describes how tumours have been extirpated with ferrum candens ever since 2,000 years B. C. Hippocrates, however, was antagonistic to the operation and his teaching obtained for many years. Leonidas (A. D. 180) was a pioneer in Surgery. He operated with knife and cauterized then the wound with ferrum candens partly to stop the bleeding and partly to burn out the remains of the tumour. This method then fell into disuse and has only quite recently been adopted again in the treatment of cancer, as by this method one closes up the blood and lymph vessels and thereby prevents an implantation of cancer during the operation and thus ought to be able to avoid local recurrences.

At Radiumhemmet the electro-coagulation has been employed in altogether 29 cases of cancer mammae. Twenty-one of these have been treated during 1921 and 1922 and can now be viewed with regard to the local recurrences. The treatment has been purely palliative in three cases. One patient has died in connection with the operation. Sixteen out of the remaining seventeen patients are alive and symptomless. In one case there was a recurrence in the axilla after 2 months and later on still another just outside of the cicatrix, the patient having subsequently died of remote metastases 1¼ year after the operation was performed. If this be counted as a local recurrence we have, thus, a percentage of 5,9 for the local recurrences. The great statisticians (PERTHES and others) give a local recurrence figure of 19—27,5 % after one year. Of the material of Radiumhemmet during 1921 and 1922 the cases of cancer mammae operated by the ordinary method show a local recurrence figure of 24,5 %, constituting thus a local recurrence of about 25 % in consequence of the ordinary technique of operation, and 5,9 % in consequence of electro-coagulation. These figures are, however, too small to allow of definite conclusions. The electro-coagulated cases of Radiumhemmet having been mostly inoperable cases, it looks, however, as though it had been possible to reduce the number of local recurrences.

Discussion:

1. I. BAGGE, Gothenburg: With regard to the taking of tissue for study from a cancer of the breast, this should be done with the aid of a coagulation instrument, for the same reasons that indicate the coagulation therapy on the whole.

As a coagulation of the entire field in cases of benign tumours involves an unnecessarily long period of healing, it is better to make the excision by means of the coagulating cautery and to make the incision in such a way that the wound may eventually be convenient to suture in a couple of days if the microscopic diagnoses shows benignity, but to let the wound remain open and heal by the formation of granulations if the diagnosis reveals malignancy.

2. E. Lysholm, Stockholm demonstrated a coagulation instrument devised by him, by which it is possible to make a section with circumscribed coagulation zone.

After the paper was read patients who had undergone electro-coagulation were demonstrated, some of them healed and some being in different stages of healing.

Dr. A. Lundquist, Stockholm, demonstrated patients who had been treated for cancer of the skin and were now healed.

Dr. E. Berven, Stockholm, demonstrated the technique of radium application employed at Radiumhemmet in cases of cancer palpebræ and also the technique employed in cases of cancer labii.

Dr. A. Lundquist, Stockholm, demonstrated a mechanical arrangement for the application of the radium in cancer labii.

Dr. E. Berven, Stockholm, gave an account of the treatment of buccal cancer by a combined method: electro-coagulation and radium application.

Dr. E. Berven demonstrated cases of benign as well as of malignant changes in the thyroid gland, who had been treated with good results.

Dr. N. Westermark, Stockholm, demonstrated patients treated for haemangioma with good result.

XXIX. Gösta Forssell, Stockholm: The Permanency of the Cure after Radium Treatment in Skin Cancer

The speaker has made an investigation as to the permanency of the cure after radium treatment in skin cancer. He has made inquiries about the subsequent state of health of the patients who were treated for skin cancer of the face at Radiumhemmet during the period 1909—1915.

He has been able to follow 93 patients belonging to this period, who had *superficial* skin cancer. Out of these were 92 who had been cured from the beginning. Only in one case had the treatment not had any favourable effect. Fourteen out of these 92 patients had had a recurrence, but 10 of these had been cured after a renewed treatment and had remained cured. Four had not been cured. In these *superficial forms of cancer* a permanent *cure* had thus been obtained *in about 95 %* of the cases.

Out of *99 patients* with *deep-seated cancer* of the face, often very serious cases, *66, or two thirds, had become cured.* Twenty-two of these had had a recurrence, but half of this number, or 11, had become cured after having repeated the treatment, and have remained cured. Altogether *54 patients* suffering from this serious form of cancer had *remained cured* in such a way

that they either are still living or has the cancer remained cured until their death of some other disease or of old age.

A cure of skin cancer after radium treatment has, thus, proved to be as permanent as after a radical surgical operation.

Radiological treatment is, however, to be preferred to a surgical interference in *skin cancer of the face* for the reason that the radium treatment is not of a mutilating nature and very often leaves hardly visible marks, which is of a great social importance in tumours of the face. The surgical operation is probably preferable in skin cancer of other regions of the body.

Discussion:

1. Dr Fr. von Bergen, Gothenburg, pointed out the difficulty in radiologically overcoming minute recurrences appearing in the scar immediately in the process of healing after the operation.

2. S. A. Heyerdahl, Christiania: I should like to ask Professor Forssell whether he has seen cases of skin cancer in quite young individuals?

I have had the opportunity of seeing two cases of rapidly growing skin cancer in young persons (14 and 15 years of age) who were refractory to the radium treatment. These cases were later on cured by operation.

In these cases I consider the radium treatment contra-indicated. Radium treatment is also contra-indicated in cases of cancer developed from lupus or in cases of Roentgen cancer. On the whole one may say that the radium treatment is contra-indicated in all cases of cancer developed from a precancerous condition.

3. G. Forssell, Stockholm: Dr. Heyerdahl has asked me whether I have observed skin cancer in the young and also about the effect of radiological treatment in these cases.

I have seen some few cases of skin cancer in young people, partly due to lupus faciei, treated with Finsen light, and partly due to skin atrophy produced by Roentgen treatment.

In these cases we have not given radiological treatment but have removed the tumours by means of electro coagulation with good result. I advise against employing radiological treatment in cases of these kinds of cancer.

Concerning the effect of the radium therapy in various histological forms of cancer I do not share the universally adopted view that squamous epithelium cancer as such is less susceptible to radiological treatment than spinocellular cancer.

I have seen very sensitive and very resistant cases of either form.

In my opinion it is, on the other hand, the *clinical character of the case* that is most determinative of its prognosis.

In a slowly progressing and clinically benign form the radiological therapy gives as a rule a better and more permanent result than in clinically more malignant forms, whichever its histological structure may be.

4. A. Reyn, Copenhagen: I want to thank Professor Forssell for his very interesting paper. I rather agree with Forssell that in carcinoma of the skin it is not so much a question of whether the carcinoma is basiocellular or spino-cellular; the important point is whether it is infiltrated

and deep. I do not remember for the moment how many of either kind I treated, but a fairly considerable number of cases, microscopically examined, have been collected. When of late I have become more moderate in my Roentgen treatment of carcinoma of the skin, the reason for this is that I have seen some cases where the carcinoma has been apparently cured and the patient therefore has stayed away, in spite of the carcinoma having increased, as it has increased beneath the skin which the patient does not notice. Suddenly the carcinoma ulcerates, and the patient returns, alarmed at the wound, and we have then a severe carcinoma difficult to treat. I think this can be prevented by performing an operation in due time. I, too, believe, like FORSSELL, that if the Roentgen treatment does not show any effect soon, one should not continue the treatment, but cease it.

Furthermore, I would say that there is hardly anybody who gets such excellent results as those obtained by FORSSELL through the radium and Roentgen treatment. FORSSELL possesses an extraordinary talent of acquiring the right technique as well as the right dosage in every single case; a talent possessed unfortunately only by very few.

Roentgenologically the lupus carcinoma has a very bad prognosis, but if operation is performed in time, its prognosis will be fairly good. FORSSELL is not quite right in his remarks about atrophic skin after light-treatment. The skin is not atrophic, it is only what the lupus has destroyed that is lost. As distinct from the Roentgen rays, the electric arc light does not produce any atrophy, on the contrary, it gives a strong and well nourished skin with great resisting power.

5. IVAR BAGGE, Gothenburg, asked professor FORSSELL how he treated leucoplacia.

6. FLEMMING-MÖLLER, Copenhagen, asked Professor FORSSELL if he has seen any case of tetany subsequent to irradiation of the thyroid gland.

7. G. FORSSELL, Stockholm: Dr. BAGGE has questioned me as to my principles in the treatment of *leukoplacia oris*. My own experience tallies with that of most authors in so far that a leukoplacia on the tongue or on the cheeks does as a rule require very large doses, approaching to those usually employed in cancer of the lips, if one is to effect a cure. The result of the treatment with the large doses is nevertheless uncertain. I have gradually come to the opinion that the most suitable thing is to give radiological treatment only in cases of leukoplacia where one has reason to suspect an incipient cancer. In such a case one has to consider whether operation or electro-coagulation or eventually radium treatment is the appropriate thing. In leukoplacia one must also bear in mind that some of the cases very likely have their cause in lues. In such cases the indication for radium treatment has to be decided with great caution.

The case of *cancer of the thyroid gland* which has been demonstrated here has, by radium treatment, been relieved of an inoperable tumour the size of a fist, and the patient has now been symptomless for more than 8 years. What is of special interest in this case, apart from the result of the healing process, is the fact that the patient does not exhibit any signs of myxedema in spite of the intense treatment and in spite of her only having been about 15 years of age at the time of the treatment. The left lobe of the thyroid gland was not directly exposed to the rays, although it must have

received a considerable quantity of rays. However, I have at my disposal two cases of malignant tumours of the thyroid gland, one of which was a sarcoma, where the operation could not be carried out, the other a cancer in the right lobe of the thyroid gland, in which cases the tumour has been removed by means of a combined radium-roentgen treatment, but where a pronounced *myxedema* has appeared in connection with the atrophy of the thyroid gland. Both of the patients have, however, been able to compensate for the atrophic symptoms by means of thyroidin tablets and are quite fit for work, one of them for the last five years and the other for the last three years. In a case of a very large goiter, recurring after operation and exhibiting grave symptoms of Basedow's disease, I have managed to get all the symptoms considerably improved by large Roentgen doses, so that the patient has again become fit for work, but simultaneously with the disappearance of the goiter there has appeared a decided, though slight, myxedema which, however, has been kept in check by means of thyroidin tablets. These cases show that it is possible to produce an atrophy of the thyroideal tissue by means of Roentgen rays. As I have pointed out on previous occasions, the chief difficulty in the radiological treatment of the Basedow goiter is not to get a sufficient dose but to *choose the proper dosage*.

In answer to the question put by doctor FLEMMING-MÖLLER I will just say that I have not observed as yet any case of tetanus after exposing the thyroid region to radium rays. But then we always cover the lateral portions of the thyroid gland during the exposure. We also cover a strip of the isthmus one or two centimeters in width in order to spare some of the glandular tissure and also to avoid as far as possible exposing the larynx to direct exposure. In this connection I would like to emphasize the necessity of covering the thyroid region during the radiation of lymphomata in the neck, especially in children, in order not to produce an unintentional effect on the thyroid gland. In fluoroscopy and repeated roentgenography it is also well to consider the great sensibility of the *thymus* in children. And more than is now usually done one ought generally to think of protecting the testicles in protracted fluoroscopy and repeated roentgenography.

XXX. J. Heyman, Stockholm: Experiences and Results in Radiological Treatment of Cancer of the Ovary

During the period 1911 to 1922 incl. a total of 68 cases of primary cancer of the ovary have been treated at Radiumhemmet in Stockholm. In 53 of these cases the diagnosis has been established anatomo-pathologically. Of the 15 cases where a histological diagnosis is lacking three are alive and only one of these has been observed for more than one year. Of the total 68 cases there were 13 inoperable, 17 recurrences subsequent to a radical operation, 20 in whom a radical operation could not be carried through (incompletely operated), and 18 prophylactically treated subsequent to a radical operation.

Of the 13 *inoperable cases* 2 are symptom-free, both of them about a year after the commencement of the treatment. In this group no permanent results have been obtained. Now and again we have had remarkable primary results.

Of 14 *cases with recurrence* which have been observed for two years or more, 28.6 % are alive two years after the commencement of the treatment, but none at the end of 5 years.

In the group of *incompletely operated*, 15 cases have been under observation for two years or more. Six of these (46.7 %) were alive two years after their first treatment, and of the 7 cases that were observed for five years or more, 3 (42.9 %) are alive 5 years after the commencement of the treatment. For several years we have had a positive impression that in these cases, where the main tumour has been extirpated, it is possible to secure good results to a far greater extent than in cases where only an exploratory laparotomy has been performed. Even if large metastases and portions of the main tumour have been left behind, the treatment may result in a long relief from symptoms. Our experiences of these cases have occasioned us to insist upon an attempt being first made to remove the main tumour in all cases of cancer of the ovaries, even in the most hopeless ones, and then to radiate.

Of the *prophylactically after-treated cases* 66.7 % lived for two years after the commencement of the treatment, and 4 out of 5 (making 80 %), five years after the first treatment. Compared with the percentage of healed cases in the statistics of operation, which figure is 30 % at the most after five years, the prophylactic post-operative treatment seems to be of some value.

No definitive conclusions can be drawn as to the treatment. In cases where radium treatment has been employed alone or in conjunction with Roentgen treatment, a somewhat better result has been obtained than by Roentgen treatment alone. It is of the greatest interest to note that in these treatments we have generally employed radium and Roentgen dosages that are materially smaller than the so-called "carcinoma dosage". As a rule, we give a treatment of 1200 mgm. hrs. Ra. El. in the uterus, and as an adjunct to this a Roentgen treatment through two abdominal and one back-field, delivering on each field 2 by 1/2 or 3 by 1/3 of a skin erythema dose. The skin-focus distance is 23 and 30 centimeters respectively, and the filter consists of 0.5 millimeters of copper.

Conclusions:

1) Operable cases should be subjected to a radical operation. Even in seemingly hopeless cases an exploratory laparotomy should be performed and the ovarian tumours removed if possible.

2) Operated cases should be radiated as soon as possible.

3) The radiation should be done with radium (preferably in the uterus) in conjunction with a careful exposure to Roentgen rays. (Cf. above.)

4) Radiation should be tried even in such cases where it has not been possible even partially to accomplish an operation.

XXXI. Axel Westman, Umeå: The Results Obtained at Radiumhemmet by a Prophylactic, Post-Operative Radium Treatment of Cancer Colli Uteri

During the period 1914—1922 twenty-nine operated cases of cancer colli uteri have undergone a prophylactic post-operative treatment at Radiumhem-

met in Stockholm, partly a combined Roentgen-radium treatment and partly only a oentgen or only a Rradium treatment. Twelve cases have been observed for at least 5 years. Four, or 33.3 %, of these are in good health, and 8, or 67.6 %, have died.

Three cases have been followed for 4 years. One, or 33.3 %, of these is well, and 2, or 66.7 %, have died.

Six cases have been followed for 4 years. Five, or 83.3 %, of these are well, and 1, or 1.16 %, has died.

Four cases have been followed for two years. Four, or 100 %, are well.

Three cases have been follo wed for 1 year. Two, or 66.7, are well, and 1, or 33.3 %, has died.

In 9 out of the 15 cases that were followed for 5 or 4 years respectively it was found, however, at the operation that the extent of the cancer was rather considerable. Thus, there were cancer glands in the pelvic walls in four cases, and in 5 cases there was such a considerable spreading of the tumour into the parametria that it could not be radically removed except in one case. Two of these cases had no recurrence. The cases from the last three years have all been well operable.

In view of the advanced cases which have earlier come under treatment and of the favourable results exhibited by the cases belonging to the last few years, the results may be considered as relatively good and calculated to support the opinion previously expressed by foreign investigators, that the prophylactic radiological after-treatment ought to complete the operative therapy of cancer colli uteri.

XXXII. G. Forssell, Stockholm: A Porcelain Applicator for Superficial Treatment with Radium

In the existing plane applicators for superficial treatment with radium, the radium salt has hitherto been incorporated in a varnish which is very delicate and for that reason has to be carefully protected.

At the suggestion of the speaker the late doctor Robert Mauzelius devised experimentally a mass of kaolin and barium sulphate which is annealed at a high temperature together with radium salt into small plates hard as glass.

In a letter dated April 19th. 1920 Dr. Mauzelius has given the following description of the procedure by which he has produced these plates, which description I am here giving in extenso:

"Of course, in these experiments one cannot (if one does not want to employ large mixtures of barium) have a mass of constant composition. For in each separate case there are two given quantities, viz. the total amount of the mass, which is determined by the dimensions of the applicator, and its percentage of radium added in the form of Ba-Ra-sulphate available for the occasion. Since these two quantities are in a variable proportion to each other, and since the radium preparation also acts as a fusing-agent, the percentage of the other fusing-agent must also be varied.

From this it follows that I am not now able to give anything but the approximate composition of the applicators which are now going to be made,

and I have calculated that for the large ones (10 by 10 mm.) we have to use about 0.18 grams of a mixture consisting of:

10 per cent of Ba-Ra-SO_4, with 55 per cent of Ra,
7 » » » "fusing-agent" and
83 » » » Kaolin.

For a fusing-agent I use partly an easily fussible glass having the composition

$$4Na_2O \cdot B_2O_3 \cdot 9\,SiO_2,$$

and partly a product obtained by fusing together equal parts of kaolin and dehydrated sodiumdimetaborate. The mixture is carefully ground in an agate mortar and a weighed out portion of it is transferred to a mould of platinum where it is stirred together with some water. With a little patience one gets finally a plastic mass which is spread out up to the rim of the mould. Having been allowed to dry, the mass is annealed in the mould, the temperature being carefully raised to slightly more than 1000° C."

The radium kaolin-plates can be sterilized by heating or boiling and are affected neither by the fluids of the body nor by antiseptic fluids. The radium salt can, on the other hand, be separated from the plate, if desired, by a simple chemical process.

Exceedingly lasting and constant radium applicators have been obtained with this material.

These radium kaolin-plates have been used to great advantage at Radiumhemmet since the summer 1920.

We have plates partly in sizes of 10 by 10 millimeters and partly in sixes of 10 by 5 millimeters, containing 10 and 5 mgm. radium element respectively.

In order to protect the thin kaolin-plates and to absorb the α-rays, the plates have been covered with a casing of nickel having a thickness of 0.2 millimeters on one surface and 0,1 millimeters on the other. The outer thickness of the nickel is 2,3 mm.

These applicators are employed for cases of superficial skin-cancer, warts, and angiomata, and also for „packs", and we have special capsules in which several applicators can be placed side by side.

XXXIII. R. Sievert, Stockholm: Some Results of Measurements Carried out with the Radium Compensator Described in Acta Radiologica Vol. II, Fasc. 2

An instrument for radium measurements has been constructed, which permits of very rapid determinations of the intensity of β- and γ-rays. Some experiments have been carried out with secondary rays from metals and water and have given results which may be of some interest for the radium therapy.

XXXIV. E. Lysholm, Stockholm: A Contrivance for Producing a Narrow Bundle of Rays in Distant Treatment by Radium

The author gives a description of an apparatus in which the radium is enclosed and suitably placed in a lead tube supplied with lead guards in all directions except towards the area to be exposed, the surface of which can be varied as required. The apparatus is employed partly as an ordinary Roentgen tube and is provided with an alarum arrangement to prevent dislodgements, and partly in direct application and is then suspended in a long wire which runs over the arms of a balance provided with pulleys in both ends, the apparatus being balanced in position by a counter-weight.

XXXV. Gunnar Lundgren, Stockholm: On the Radiological Treatment of Hypophyseal Tumours

Not considering the cases of the last two years ten cases of hypophyseal tumours have been positively diagnosed at Radiumhemmet, the Seraphimer Hospital and the Private Roentgen Institute of Professor Forssell, two of these cases having exhibited symptoms of acromegaly. All cases have exhibited visual disturbances. Eight cases have become distinctly improved; the power of vision has again been increased and the headache has disappeared in those cases where it existed. In two cases there has only been temporary improvement, but in these cases the disease was in a very advanced stage. In none of the improved cases has there been a subsequent change for the worse. The time of observation varies between $8^1/_2$ and 3 years.

Four cases of pure acromegaly without visual disturbances have been treated. All of these have shown improvement after a short treatment and the acromegalous changes have ceased. A continued treatment has not had any further effect on the disease which, however, has not shown signs of progressing. The time of observation has been from $3^1/_2$ to 8 years.

An analysis shows that the disease is favourably influenced by Roentgen treatment, which result fully agrees with the reports on about fifty cases in the literature. The treatment influences the pressure symptoms as well as the hyperaction of the hypophysis. The comparison also shows that the good result is permanent, at least for a long course of years, which fact has previously been pointed out only in one or two cases.

XXXVI. A. Lundquist, Stockholm: The Blood Picture after Irradiation of the Spleen

From what has been indicated by an examination of the blood picture after irradiation of the spleen with relatively small doses, about equivalent

to the so-called stimulation dosages which has been reported by STEPHAN, an early and rapidly passing lymphocytosis may set in, which may possibly be interpreted as a stimulation of the spleen,—whether it be produced directly by the Roentgen rays or by the effect of the breaking down products. An increased resistance of the red blood corpuscles, which has been observed in some cases, argues also in favour of an increased splenic function.

List of Members Attending the Congress

From Denmark.

Dr. Baastrup, Chr. J., Copenhagen
» Bentzon, P. G. K., »
» Krebs, Carl, Aarhus.
Mr. Kühl, Johan, C. E., Copenhagen.
» Larsen, Holger, C. E., »
» Lassen, K. C. » »
Dr. Lau, Knud, Faxe.
» Maag, A., Odense.
» Möller, P. Flemming, Copenhagen.
Mr. Palle, J., C. E., Copenhagen.
Dr. Panner, J. H., »
» Rames, Einar O., Aarhus.
» Reyn, A., Copenhagen.
» Riis, Chr., Aarhus.
» Sonne, Carl, Copenhagen.
» Wegge, Kai, Skovshoved.

From Finland.

Dr. Emeleus, N., Tammerfors.
» Jansson, Gösta C., Helsingfors.
» Lindström, Ludvig, Vasa.
» Wetterstrand, G. A., Helsingfors.

From Iceland.

Dr. Claessen, G., Reykjavik.

From Norway.

Dr. Amundsen, P., Christiania.
» Bakke, Sigv., Aker
» Berle, E., Christiania.
» Brodersen, J., Drammen.
» Gundersen, E., Christiansand.
» Heyerdahl, S. A., Christiania.
» Klason, T., Bergen.
» Nitter, H., Skien.
Dr. Norland, Stavanger.
» Schiander, A. W., Christiania.
» Sverre, Ingemann, »
» Thue, Hans, Christiania.

From Sweden.

Dr. Åkerlund, Åke, Stockholm.
» Almbladh, Emil, Mönsterås.
» Bagge, Ivar, Gothenburg.
» von Bergen, Fr., Gothenburg.
» Berven, Elis, Stockholm.
» Bohmansson, Gösta, Umeå.
» Carlsten, Dag, Malmö.
Prof. Forssell, Gösta, Stockholm.
Dr. Hansson, Nils »
» Heyman, James, »
Mr. Järnh, Bror E., C. E. »
Dr. Karsten, Aug., »
» Key, Einar, »
» Larsén, T., »
» Laurell, Hugo, Upsala.
» Lindqvist, Silas, Södertälje.
» Lundgren, Gunnar, Stockholm.
» Lundqvist, Arvid, »
» » Birger, »
» Lysholm, Erik, »
» Morsing, W. Boden.
» Odelberg-Johnson, G., Uttran.
Mr. Odenkrantz, A., Ph. D., Stockholm.
Dr. Odqvist, Henning, Gothenburg.
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» Westermark, Nils, Stockholm.
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